Aviation Week & Space Technology

75 Cents

A McGraw-Hill Publication

October 21, 1963

Sweden Plans 1970s Air Force Around Viggen

New Centaur Vent Stack Tested at Lewis Center

Volumes of Performance from Voi-Shan

Voi Shan is noted for its ability to manufacture high-performance bolts, nuts and other precision fastening devices for the aircraft/missile industry. It is the nation's pioneer in Titanium bolt manufacturing and also employs such exotic materials as Beryllium, Zirconium, Tantalum, Columbium, Tungsten and Molybdenum. Exotic materials are constantly being experimented with for their potential use as high performance fasteners.

The table shown, is representative of Voi-Shan's range of experience in the manufacture of high strength and high temperature bolts. Write for descriptive literature on these and other Voi-Shan quality products.

Material	Room Temperature Minimum Ultimate Tensile Strengths (Typical)	Typical Temperature Usage Range	Typical Head Configurations
Alloy Steal	160,000 psi	−100 thru +500°F	100°Flat Head Internal
A 286 Corrosion Resistant Steel	160,000 psi	−423 thru +1200°F	or External Hex or External 12 pt. Wrenching
M 252	170,000 psi	−423 thru +1400°F	Threads MIL S 7742 (Class 3A)
Alloy Steel	180,000 psi	−100 thru +500°F	100° Flat Head Internal
René 41	180,000 psi	−423 thru +1600°F	or External Hex or
K Monel	180,000 psi	−423 thru +1000°F	External 12 pt. Wrenching
Udimet 700	240,000 psi	−423 thru +1600°F	
A 286 Corrosion Resistant Steel	200,000 psi	−423 thru +1200°F	Threads MIL S 7742
Titanium Alloy	200,000 psi	−325 thru +750°F	MIL S 8879 (Class 3A)
Hy Tuf	220,000 psi	−100 thru +550°F	Internal or External Hex or
Various	220,000 psi	−100 thru +900°F	External 12 pt. Wrenching
5% Chrome	260,000 psi	−100 thru +900°F	
Ota Steals	280,000 psi	−100 thru +900°F	
Inconel 718	260,000 psi	−423 thru +1600°F	Threads MIL S-8879 (Class 3A)
Waspaloy	260,000 psi	−423 thru +1800°F	
Mar Aging Steel	300,000 psi	−320 thru +900°F	
Pure and/or alloyed	**REFRACTORY FASTENERS**		
Molybdenum	Minimum ultimate tensile values vary according to the specific alloy and application temperature	up to +2500°F	Flush and Protruding
Columbium		up to +2800°F	Head Styles
Tantalum		up to +3600°F	Threads Voi-Shan
Tungsten		up to +5500°F	Special Design

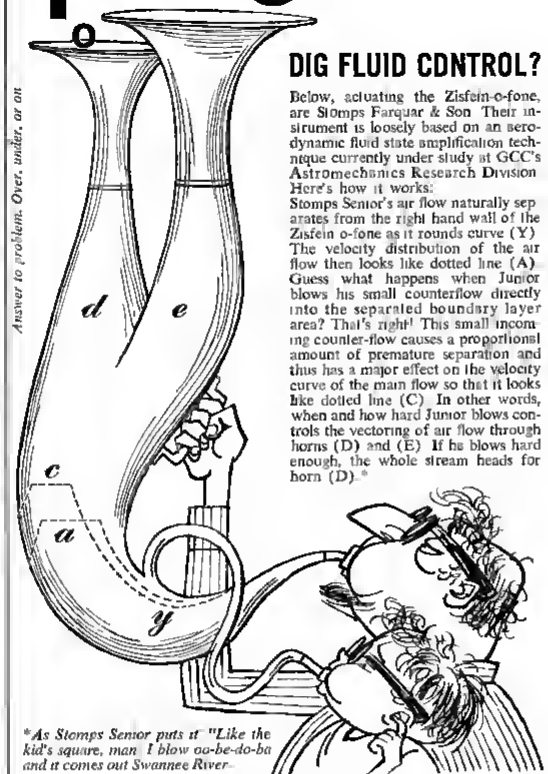
VOI-SHAN MANUFACTURING COMPANY A DIVISION OF VSI CORPORATION
8463 HIGUERA STREET, CULVER CITY, CALIFORNIA

on target with turboshaft power for the LOH—the Light Observation Helicopter which will soon be helping the Army fulfill its mission. The only LOH engine to have both US Army approval and FAA certification, the Allison T63 was selected for the LOH because of its light weight, power, simplicity, compactness and ease of maintenance. Now proving its capabilities in airframe evaluation flight tests for the Army, the T63 has over 1,000 flight hours, hit every performance and delivery target set for it. That kind of bull's eye performance is the big reason why our other aerospace and nuclear programs are also on target.

Allison
THE ENERGY CONVERSION DIVISION OF GENERAL MOTORS INDIANAPOLIS IND

POOTPOURRI

Answer to problem. Over, under, or on

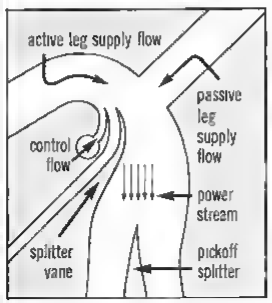


DIG FLUID CONTROL?

Below, actuating the Zisfein-o-fone, are Stomps Farquar & Son. Their instrument is loosely based on an aerodynamic fluid state amplification technique currently under study at GCC's Astromechanics Research Division. Here's how it works:

Stomps Senior's air flow naturally separates from the right hand wall of the Zisfein o-fone as it rounds curve (Y). The velocity distribution of the air flow then looks like dotted line (A). Guess what happens when Junior blows his small counterflow directly into the separated boundary layer area? That's right! This small incoming counter-flow causes a proportional amount of premature separation and thus has a major effect on the velocity curve of the main flow so that it looks like dotted line (C). In other words, when and how hard Junior blows controls the vectoring of air flow through horns (D) and (E). If he blows hard enough, the whole stream heads for horn (D).*

**As Stomps Senior puts it: "Like the kid's square, man. I blow oo-be-do-ba and it comes out Swannee River."*



NOW, FOR THE REAL McCOY

At the left is a diagram of a real, live, GCC developed fluid state device. We anatomically call it the Double Leg Elbow (not "Hip", says Farquar Sr.) Amplifier. As fluid state devices go—and few of them go very well yet—it's a nice piece of work. This no-moving parts, non-electronic, non-hydraulic, non-mechanical, non-available proportional mass flow amplifier has yielded very linear single stage differential flow gains over 200 to 1. That is worth knowing more about, isn't it? For a detailed report on how the Double Leg Elbow Amplifier works plus disclosure of a whole batch of data developed during our fluid state endeavors send us your name and address on a company letterhead.

AEROSPACE CALENDAR

Oct. 28-29—13th Annual Aerospace Fluid Power Conference, Pick-Fort Shelby Hotel, Detroit, Mich. Sponsor: Aerospace Div. of Vickers Inc.

Oct. 28-29—Fall Meeting, Western States Section/The Combustion Institute, University of Southern California, Los Angeles, Calif.

Oct. 28-30—National Electronics Conference, McCormick Place, Chicago, Ill.

Oct. 29-31—International Symposium on Plasma Phenomena and Measurements, Institute of Electrical and Electronics Engineers, El Cortez Hotel, San Diego.

Oct. 30-Nov. 1—Annual Convention, Southeastern Airport Managers Assn., Roanoke Hotel, Roanoke, Va.

Oct. 31-Nov. 1—1963 Electron Devices Meeting, Institute of Electrical and Electronics Engineers, Sheraton Park Hotel, Washington, D.C.

Oct. 31-Nov. 1—Fall Quarterly Regional Meeting, Assn. of Local Transport Airlines, Royal Hawaiian Hotel, Honolulu.

Nov. 1-2—Symposium Technological Explosion, Albuquerque, N. M. Sponsors: American Society of Mechanical Engineers, University of New Mexico.

Nov. 3-8—International Air Safety Seminar, Flight Safety Foundation, Athens, Greece. For FSF members and by invitation.

Nov. 4-5—Annual General Meeting, Air Transport Assn. of Canada, Seigniory Club, Montebello, Quebec, Canada.

Nov. 4-6—Vehicle Design and Propulsion

(Continued on page 7)

AVIATION WEEK & Space Technology

October 21, 1963

Vol. 79, No. 17

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948). Founder. See panel below for directions regarding subscription or change of address. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York, N. Y. 10036. Entered at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Shelton Fisher, President-Vice Presidents: George H. Reppert, Jr., Operations; John R. Callahan, Editorial; Leon E. DeGraf, Circulation; Donald C. McGraw, Jr., Advertising Sales; Angelo H. Venezian, Marketing. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

Available only to paid subscribers. Publisher reserves the right to refuse non-qualified subscriptions. Subscriptions to Aviation Week solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription orders forwarded to address shown in box below.

Available to Government officials and military officers professionally concerned with aerospace via the Federal Supply Schedule. Send requisitions identifying subscriber's title or rank) direct to Circulation Manager, Aviation Week, 330 West 42nd Street, New York, New York, 10036. Specific FSS Stock Requisition Number 7610-927-3125. Index No. 255. FSC Group 76, Part III.

Single copies 75¢. Subscription rates—United States and possessions, $8 one year; Canada $8 one year. All other countries $20 one year.

Our primary aim is to provide subscribers with a useful and valuable publication. Your comments and suggestions for improvement are encouraged and will be most welcome. The publisher upon written request, agrees to refund the part of the subscription price applying to the remaining unfilled portion of the subscription—if service is unsatisfactory.

Second class postage paid at Albany, N. Y. Printed in U. S. A.

Subscribers: Send correspondence and change of address to: Fulfillment Manager, Aviation Week, P. O. Box 430, Hightstown, N. J. 08520. Subscribers should notify Fulfillment Manager promptly if any part of address (including old as well as new address, including postal zone number). Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Fulfillment Manager, Aviation Week & Space Technology, P. O. Box 430, Hightstown, N. J. 08520.

AEROSPACE CALENDAR

(Continued from page 5)

Meeting, American Institute of Aeronautics and Astronautics/Air Force Systems Command, Wright Patterson AFB, Dayton, Ohio. (Classified.)

Nov. 4-6—Northeast Electronics Research and Engineering Meeting (NEREM), Institute of Electrical and Electronics Engineers, Commonwealth Armory/Somerset Hotel, Boston, Mass.

Nov. 4-6—Noise Analysis in Nuclear Systems Conference, Gainesville, Fla. Sponsors: Atomic Energy Commission/University of Florida.

Nov. 4-6—First Meeting, Society of Engineering Science, Purdue University, Lafayette, Ind.

Nov. 5-15-17th Institute on Air Transportation Management. For information: Dr. Marvin L. Fair, Director, Transportation Program, The American University, 1901 F St., N.W., Washington, D.C.

Nov. 6-7—Low Cost Navigation Symposium, Airport Marine, Los Angeles, Calif. Sponsors: Institute of Navigation; Instrument Div., Lear Siegler, Inc.

Nov. 6-8—Annual Meeting and Exposition, Society for Experimental Stress Analysis, Statler Hilton Hotel, Boston, Mass.

Nov. 7-8—24th National Meeting, Operations Research Society of America, Olympic Hotel, Seattle, Wash.

Nov. 7-8—Joint Technical Conference, Disneyland Hotel, Anaheim, Calif.: American Society of Mechanical Engineers; American Institute of Aeronautics and Astronautics; Society of Automotive Engineers; American Society for Quality Control.

Nov. 9-11—1963 Space Fair, Pacific Missile Range Headquarters, Point Mugu, Calif.

Nov. 11-15—Institute on Reliability Engineering and Management, Tucson, Ariz. Sponsors: University of Arizona/Northrop Space Laboratories.

Nov. 12-14—Symposium on Supersonic Airliners, London, England. Sponsors: British, French and U.S. Air Line Pilot Associations.

Nov. 12-14—Fall Joint Computer Conference, American Federation of Information Processing Societies, Las Vegas Convention Center, Las Vegas, Nev.

Nov. 13-14—Seminar on Automatic Check-out Equipment and Techniques, Columbus, Ohio. Co-sponsors: NASA's George C. Marshall Space Flight Center, Battelle Memorial Institute.

Nov. 13-14—Fifth General Assembly, International Technical Institute for Flight Engineers, La Maison des Ailes, Brussels, Belgium.

Nov. 13-15—18th Annual Meeting, Armed Forces Chemical Assn., Statler-Hilton Hotel, Washington, D.C. Host: Air Force.

Nov. 18-19—Symposium on Unconventional Inertial Sensors, Farmingdale, N.Y. Sponsors: Republic Aviation Corp.; N.Y. Scientific and Technical Liaison Office, Air Force Systems Command's Research and Technology Div., Bureau of Naval Weapons. (Classified.)

Nov. 18-20—Sixth National Symposium, Society of Aerospace Material and Process Engineers, Olympic Hotel, Seattle, Wash.

(Continued on page 9)

AEROSPACE CALENDAR

(Continued from page 7)

Nov. 18-22—10th National Plastics Exposition. Society of the Plastics Industry. McCormick Place, Chicago, Ill.

Nov. 19-21—1963 AtomFair. Hotel Americana, New York, N. Y. Co-sponsors: Atomic Industrial Forum, American Nuclear Society.

Nov. 19-21—Conference on Stratosphere Mesosphere Structure. El Paso, Tex. Sponsors: Texas Western College, American Meteorological Society, AIAA.

Nov. 19-21—42nd Annual Meeting. Aviation Distributors and Manufacturers Assn., Shamrock Hilton, Houston, Tex.

Dec. 3-5—Joint Annual Meeting and Convention. National Pilots Assn. and National Aviation Trades Assn. including the National Air Taxi Conference. Fontainebleau Hotel, Miami Beach, Fla.

Dec. 3-5—33rd Symposium on Shock Vibration and Associated Environments. U. S. Naval Research Laboratory, Washington, D. C.

Dec. 3-5—Annual Meeting, Assembly of the Radio Technical Commission for Aeronautics, Washington, D. C.

Dec. 4-6—Testing of Manned Flight Systems Conference, American Institute of Aeronautics and Astronautics/NASA Flight Research Center, Edwards AFB, Calif.

Dec. 4-6—Ultrasonics Engineering Symposium, Institute of Electrical and Electronics Engineers, Marriott Motor Hotel, Washington, D. C.

Dec. 5-6—14th National Conference on Vehicular Communications, Institute of Electrical and Electronics Engineers. Adolphus Hotel, Dallas, Tex.

Dec. 6—Fourth Annual Seminar on the Reliability of Space Vehicles, Institute of Electrical and Electronics Engineers. Airport Marina Hotel, Los Angeles.

Dec. 11-13—Conference on Heterogeneous Combustion, American Institute of Aeronautics and Astronautics, Palm Beach.

Dec. 16-17—Conference on Non-Linear Processes in the Ionosphere, National Bureau of Standards Boulder Laboratories, Boulder, Colo.

Dec. 16—Sixth Annual Army Aviation Contract Services Symposium. Mayflower Hotel, Washington, D. C. Sponsor: National AeroSpace Services Assn.

Dec. 30—Annual Meeting, American Assn. for the Advancement of Science, Cleveland, Ohio.

Jan. 7-9—Tenth National Symposium on Reliability and Quality Control. Statler Hilton Hotel, Washington, D. C.

Jan. 19-23—16th Annual Convention. Helicopter Assn. of America. San Marcos Inn, Chandler, Ariz.

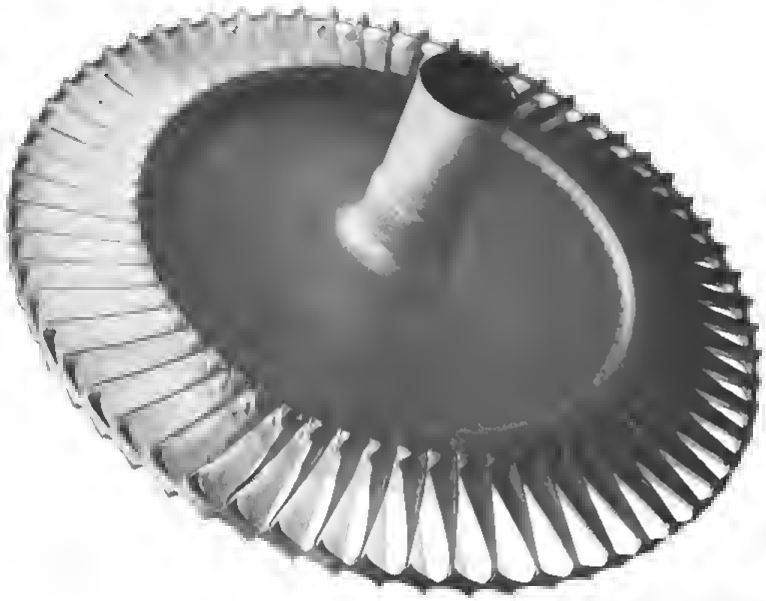
Jan. 20-23—Annual Winter Meeting, American Institute of Aeronautics and Astronautics. Hotel Astor, New York, N. Y.

Mar. 23-26—International Convention, Institute of Electrical and Electronics Engineers, Coliseum and New York Hilton, New York, N. Y.

Apr. 24-May 3—1964 German Air Show. Hanover Airport, Hanover, West Germany.

Sept. 7-13—1964 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

HERE'S A LOW-ALLOY, LOW-COST TIMKEN® STEEL THAT MADE THE GRADE IN FLIGHT



Avco/Lycoming's T53 2nd stage gas turbine disc is made of Timken® 17-22-A(S) steel containing less than 3% alloy

IT CAN KEEP YOUR COSTS DOWN TO EARTH

Although it has less than 3% alloy content, Timken® "17-22-A" steel holds its maximum strength up to 1100°F. It has a further advantage over many exotic high alloy steels in hot working. You can forge or work this steel up to 2300°F—machine and weld it easily. Resistance to heat checking and thermal cracking is excellent. Normalizing and tempering develop the maximum high temperature characteristics of "17-22-A" steel. And there's almost no possibility of distortion and quench cracking.

Timken "17-22-A" steel has been widely used for aircraft brake discs for years, and now is being used more and more in gas turbine engine discs, as well as other aircraft and space applications. If you want more information about "17-22-A", send for our free 44-page Technical Bulletin 36B. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

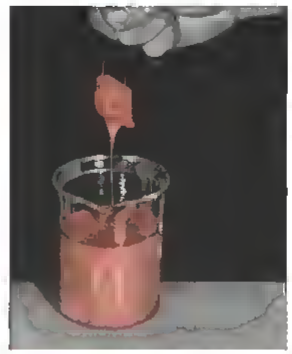
TIMKEN® FINE ALLOY STEEL

TIMKEN ALLOY STEEL ARE STAINLESS STEEL TUBING ARE AVAILABLE FROM STEEL SERVICE CENTERS IN MORE THAN 70 CITIES IN THE UNITED STATES

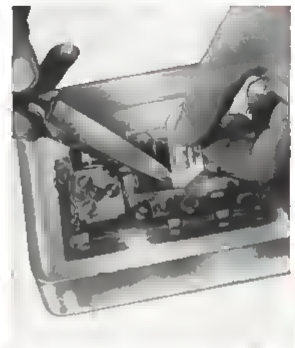
SILICONES

What you can do with General Electric's versatile RTV silicone compounds

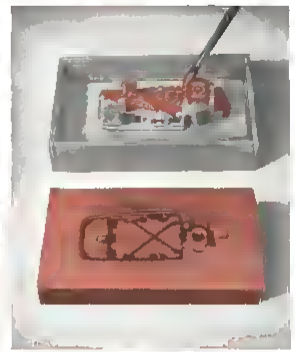
to insulate, seal and mold from –150°F to 500°F



Encapsulate it. Fluid RTV silicone rubber penetrates deep into transformer coils. RTV has excellent dielectric strength and practically no shrinkage. Cure time at room temperature can be varied from minutes to hours.



Pot it. Transparent or opaque, G-E silicones provide a resilient protection against moisture, ozone, thermal and mechanical shock. Flows freely around complicated parts, can be cut away to replace internal components.



Duplicate it. Flexible RTV is often used to make molds for prototypes and short run production. This part requires deep undercutting, but duplicate parts flex free easily. RTV's tensile strength is as high as 850 psi.

Seal it. Bondable RTV (when surface is properly primed) seals against moisture and vibration, ozone and chemicals. Can be used for sheet metal fabrication, shock mounts, gasketing. Viscosities range from pourable to paste.

Insulate it. Adhesive/sealant RTV-102 requires no mixing of catalyst, can be used to insulate open wiring for on-the-spot caulking, gluing and soldering. RTVs are virtually ageless, will not stress-crack or weather.

Manufacture it. RTV adhesive/sealants are fast working assembly tools, eliminate prefabricated parts or more costly, time consuming techniques. Here an RTV adhesive laminates flexible mica strips to form cylindrical ducts.

If you would like a free sample of one of the nine General Electric RTV silicones for evaluation, write on your letterhead describing your application. For additional information, check reader service card Section 31095 Silicone Products Dept. General Electric Company, Waterford, New York.

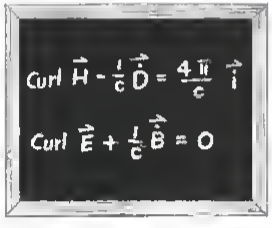
GENERAL ELECTRIC

RESEARCH

to fire the imagination, advance the state of the art

Research at THIOKOL covers the whole spectrum of Science

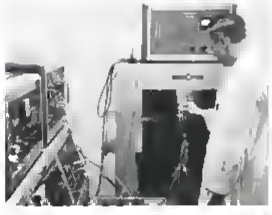
There is no discipline in the physical sciences which Thiokol does not actively investigate While THIOKOL's major interest is the utilization of research to improve rocket engine performance and reliability—this work is based on the most fundamental concepts of science Maxwell's electromagnetic equations, for example



James Maxwell laid these foundation blocks of electro-magnetic theory in 1864 Then, the only practical source of electricity was the chemical battery, and its only widespread use, the telegraph. Today, Thiokol is applying Maxwell's Equations to the interactions between electromagnetic fields and plasmas Spectroscopic, micro wave and other methods are used to relate temperature, charge concentration and other plasma properties to present theory Applications of interest are magneto hydrodynamic thrust and power generation, and propagation of radio frequency spectrum through weakly ionized gas

Structure of Macromolecules

In the realm of the investigation of the composition and structure of molecules, Thiokol Chemical Corporation has left the test tube behind The Nuclear Magnetic Resonance Spertrometer shown here is one of



the new tools of science we are utilizing in this area. This device takes advantage of the fact that certain atomic nuclei have magnetic moments When a compound containing such nuclei is placed in a magnetic field and subjected to radio frequency energy, oscillations occur which can be recorded. By this means a large variety of groups and bonds can be differentiated This technique, in conjunction with other modern chemical analytical tools such as infra red, mass spectrometer, ultra violet absorption, gas chromatography will determine rapidly and efficiently the structure of the most intractable molecule Samples as small as a millionth of a gram can be analyzed and, quite often, need not be destroyed by analysis With these analytical tools, Thiokol is studying the structure of the complex macromolecules that find use in such diverse areas as propellant binders, potting compounds and structural-joint sealants

Anatomy of Flames

Flames are the most complex high temperature chemical systems known. The above structured rocket exhaust, illustrating the conversion of random heat motion to directed thrust, is but one of their many applications At Thiokol we are probing flames and high velocity exhausts for chemical species, as well as determining more mundane properties Light emission and absorption, from the ultra-violet to the infra-red are also measured. These results provide a basis for the development of exotic fuels, for the design of more efficient rocket components and for the determination of the properties of missile exhaust.

Reservoir of knowledge

Thiokol research in its pure and applied forms is adding to the total sum of man's knowledge. Challenging openings exist for creative scientists versed and interested in these areas Applications are welcome

Thiokol
CHEMICAL CORPORATION
Bristol Pennsylvania
Rocket Operations Center Ogden Utah
An equal opportunity employer

From Fafnir –

computer-programmed bearing reliability for turbine-powered helicopters

Time was when helicopter transmission bearings could be selected right from the catalogs. But no more. In turbine-powered 'copters, especially, many gearbox bearings must be custom-engineered.

Fafnir is a major supplier of such bearings — and the leader in applying advanced computer techniques to bearing engineering. The gearbox bearings shown above are good examples.

The application demanded extremely rigid shaft support and high running accuracies under conditions of severe vibration. Bearing load capacity, weight, and size were critical, too.

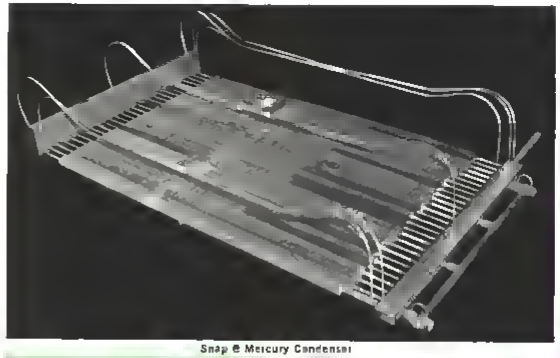
An IBM 7090 computer analysis helped Fafnir engineers explore design alternatives and determine optimum bearing characteristics. Result: a duplex set of angular contact bearings precisely engineered for maximum performance and load-life requirements.

Chances are, the "computer approach" at Fafnir can help you meet critical needs precisely . . . and with utmost reliability. Investigate. Remember: "Fafnir" on your bearings assures sound engineering, highest quality, full value at a fair price. The Fafnir Bearing Company, New Britain, Conn.

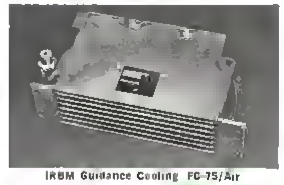
FAFNIR DUPLEX BEARING SET FOR HELICOPTER GEARBOX

Flanged WI type bearing with companion WO type bearing manufactured to ABEC 7 limits. Rings and balls of high-strength vacuum-melt M-50 steel made by consumable electrode process are 100% magnetic particle and surface temper inspected. Machined bronze retainers are 100% fluorescent penetrant inspected.

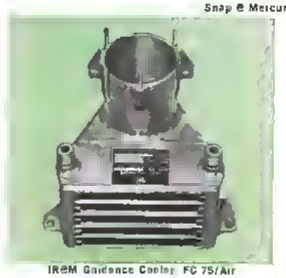
FAFNIR
BALL BEARINGS



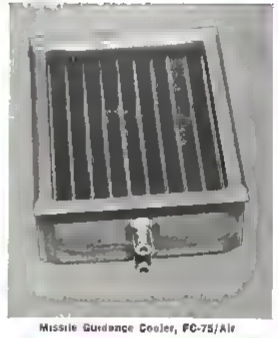
Snap 8 Mercury Condenser



IRBM Guidance Cooling FC-75/Air

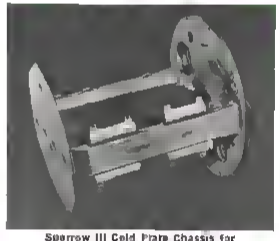


IRBM Guidance Cooler FC-75/Air

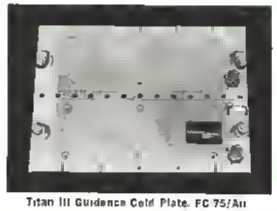


Missile Guidance Cooler, FC-75/Air

Sparrow III Electronic Guidance Cooling OS-45/Air



Sparrow III Cold Plate Chassis for Electronic Cooling Air



Titan III Guidance Cold Plate, FC-75/Air

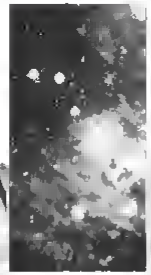
Missile Launch Vehicle Hydraulic Cooling Air/Oil

INFINITY

Fins, fins, fins. Plain fins, slotted fins, ruffled fins, lanced fins, stripped fins. Cold and hot fluid circuit fins of different heights, thicknesses, densities and materials. UAP can design and build *secondary surface heat exchangers* of the plate-and-fin type to meet your precise requirements. We make all types of fins in our own plant, and employ our own outstanding dip-braze facilities. This shortens lead time, gives you better delivery. And to speed design time, UAP has programmed a digital computer for an infinite amount of heat exchanger information derived from experience and testing, plus engineering performance data. The computer can quickly indicate what type of fin is best for your application in terms of pressure drop, heat rejection, weight, size and other factors. For details, write . . . or phone 224-3841 today. UAP means United Aircraft Products. *Since 1929 a dynamic, independent company in Dayton, Ohio. A name to remember when it comes to plate-and-fin heat exchangers.*

Outstanding opportunities for qualified engineers.

UAP



Space-the youthful outlook

Space-General offers unlimited opportunities for engineers and scientists who want to move ahead quickly in a dynamic young organization dedicated to space projects. ■ Less than three years old, Space-General now has grown to almost 1,200 employees and occupies one of the newest, best-equipped facilities in the industry. Location is ideal — in the San Gabriel Valley, 15 minutes by freeway from downtown Los Angeles. ■ Our current interests are broad: electronics, guidance and control systems, space telemetry, survivable communications, satellite and military systems, space vehicles, lunar and planetary exploration craft, inflatable reentry vehicles, and nuclear detection studies. ■ Our employees tell us they prize Space General's unusually heavy emphasis on *individual* work and ideas. As a matter of fact, every member of our technical staff is expected to make a creative contribution to the growth of our technological capability.

There are many outstanding career opportunities at Space-General for engineers and scientists with a B.S. degree or higher and at least two years of experience in any of the following fields. Communication Systems Analysis • Circuit Design • Heat Transfer Thermodynamics Analysis • Stress Analysis • Trajectory Analysis and Aerodynamics • Hydraulic-Pneumatic Controls Development • Structural Test Analysis • Space Vehicle Design • Guidance and Control Analysis • Advanced Sensor Research • Microwave Research • Nuclear Test Instrumentation • Bio-Sensor Research. ■ Your resume will receive immediate confidential attention. *Send to:* Donald L. Craig, Employment Mgr., Space-General Corp., Dept. No. NP 13, 9200 E. Flair Drive, El Monte, California.

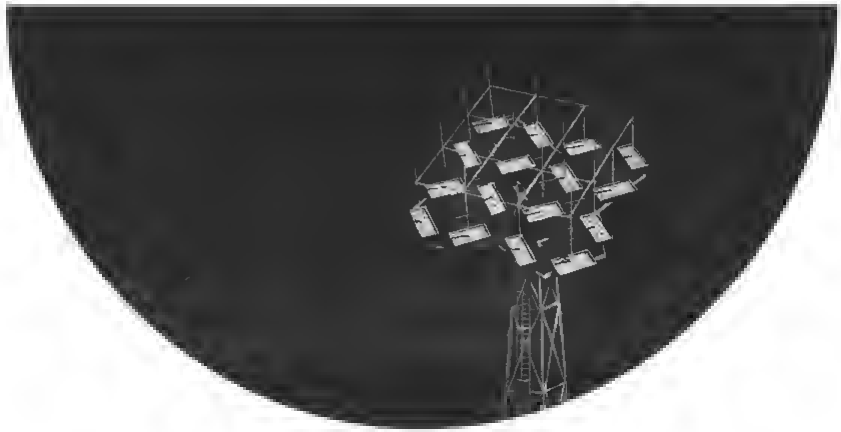
An equal opportunity employer

SPACE GENERAL TIRE GENERAL

SPACE-GENERAL CORPORATION
El Monte, California
A subsidiary of Aerojet-General Corporation

DALMO VICTOR PUTS "SATAN" TO WORK FOR NASA *Project "Satan" improves capability and reliability for data acquisition, telemetry and command. Thus NASA's Goddard Space Flight Center's worldwide Satellite Tracking and Data Acquisition stations perform pre-designated tasks on the various satellite programs—automatically and with minimum maintenance. ☐ Project "Satan" is an example of the key role played by Dalmo Victor in development work with NASA scientists, and in the manufacture of high-performance aerospace systems. DV is in the vanguard of new developments in its major product areas. If you are interested in becoming part of these challenging programs, Dalmo Victor currently is inviting applications from qualified scientists and engineers. For further information contact: Director, Scientific and Engineering Personnel.*

DALMO VICTOR COMPANY *1515 INDUSTRIAL WAY • BELMONT, CALIF.* A textron COMPANY



Aviation Week & Space Technology

Volume 79
Number 17

October 21, 1963

CONTENTS

COVER: Scale model of a Centaur launch vehicle with a redesigned liquid hydrogen vent stack (shown exhausting) undergoes a wind tunnel test at National Aeronautics and Space Administration's Lewis Research Center. Engineers want to keep the hydrogen plume away from the main engines to avoid ignition. For more information on Centaur, see p. 75.

PICTURE CREDITS

Cover—Bill Bowles, NAEA Lewis Research Center; 31—Fairchild Stratos Corp.; 33, 34—Douglas Aircraft Co.; 39, 45—Short Bros. & Harland; 64—NASA; 65—Aviation Week; 69—Long-Temco-Vaught; 75—NASA; 81—USAF; 95—Electro-Optical Systems.

Member ABP and ABC

91,632 copies of this issue printed

PUBLISHED — Robert W. Martin, Jr.
EDITOR — Robert B. Hotz

MANAGING EDITOR — William Gregory

SENIOR EDITORS
Carl Brownlow, L. L. Doty, Philip Klass, Irving Stone

EUROPEAN EDITOR — Cecil Brownlow

BUREAU CHIEFS
WASHINGTON — Edward H. Kolcum
LOS ANGELES — Irving Stone
DALLAS — Erwin J. Bulban
LONDON — Herbert J. Coleman
CAPE CANAVERAL — George Alexander

NEWS EDITOR — James O. Hendrickx
DESK EDITORS — Richard G. O'Lone, Kenneth J. Stein, William J. Normyle
AVIONICS EDITOR — Philip J. Klass
ASSISTANT — Barry Miller
TRANSPORT EDITOR — L. L. Doty
ASSISTANTS — Robert H. Cook, James B. Ashlock, Edith Walford
ENGINEERING — Michael L. Yaffee, Donald E. Fink, C. M. Plattner, Warren C. Wetmore, Roderick B. Hibben
SPACE TECHNOLOGY — Alfred P. Althrando
MILITARY EDITOR — Larry Booda
MANAGEMENT EDITOR — Harold D. Watkins
BUSINESS FLYING — Erwin J. Bulban, David A. Brown
CONGRESS — George C. Wilson, Katherine Johnson
EQUIPMENT — Ward Wright
ART EDITOR — Lawrence J. Herb
ASSISTANT — Mary Wilkins
EDITORIAL PRODUCTION — Frank Miazga
ASSISTANT EDITOR — Ann Dunphy
EDITORIAL ASSISTANTS — Marjorie Todd, Maureen Whitaker, Susan Thorn
LIBRARIAN — Wana Wu

FOREIGN NEWS SERVICE
BONN — John Wilhelm
PARIS — Robert E. Farrell
MOSCOW — Stewart Ramsay

SALES (Tel.: 212-971-3376)
ADVERTISING SALES MANAGER — E. P. Blanchard, Jr.
ATLANTA — J. A. Lane, Jr.
BOSTON — D. C. Jerkman
CHICAGO — J. E. Costello
DALLAS — John Grant
DENVER — John W. Patten
DETROIT — M. Hulburd
HOUSTON — B. George
LOS ANGELES — C. F. McReynolds, D. T. Brannan, C. A. Ransdell
NEW YORK — M. J. Stern, R. Wallace, J. D. Warth
PHILADELPHIA — J. D. Willis, M. Hammer
PITTSBURGH — J. R. Pierce
SAN FRANCISCO — B. B. Bulera
ST. LOUIS — T. H. Hunter, Tr.
GENEVA — Sylvie de Navarre
LONDON — E. S. Murphy

MARKETING (Tel.: 212-971-2085)
PROMOTION & MARKETING MGR. — C. C. Carson
RESEARCH MANAGER — H. M. Bevan
MERCHANDISING MANAGER — J. B. Gerard
ASSOCIATES — P. W. Ahrens, R. Artery

BUSINESS (Tel.: 212-971-3280)
BUSINESS MANAGER — J. G. Johnson
ASST. BUSINESS MANAGER — W. V. Carlson
PRODUCTION MANAGER — F. A. Duba

CIRCULATION (Tel.: 212-971-2660)
CIRCULATION MANAGER — T. J. Lucey

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: 212-971-3807. Washington 4, D. C.—National Press Bldg., Phone: 202 NAtional 8-5414, Republic 7-8430. Los Angeles 17—1125 West Sixth St., Phone: 213 HUntley 2-5450, Dallas 1—7712 Commerce St., Phone: 214 Riverside 7-9721, Cape Canaveral—P.O. Box 1838, Cocoa Beach, Fla., Phone: 305 783-0400. European Office—7 rue du Temple, Geneve, Switzerland, Phone: 32 35 43, London—34 Dover St., London W.1, Eng., Phone: Hyde Park 7451

EDITORIAL

Racing Again

After some sad intervals of indecision, the United States last week apparently got back into two of the key technological races of this decade with a renewed determination to try to win them. The boost given the supersonic transport program by the willingness of four U.S. airlines to ante down payments for delivery positions on a theoretical production line should certainly stimulate the bureaucrats who are running this program to more vigorous effort. It should also indicate to Congress that this is an important national effort with a solid economic prize at stake in addition to whatever prestige may be involved.

It is somehow typical of the manner in which any federal program seems bound to operate that, when confronted with certified checks totalling some $2.1 million, the Federal Aviation Agency was perplexed because it could not find the correct bureaucratic slot in which to deposit them. We rather doubt if our Anglo-French competitors would display FAA Administrator Najeeb Halaby's reluctance to accept such quantities of cash.

Canny Managers

There is as much vagueness about these orders as there is about what kind of a supersonic transport will eventually fly the U.S. flag. Certainly such canny airline managers as C. R. Smith of American and Juan Trippe of Pan American are not going to stake their competitive futures solely on the FAA's eventual product or the pace of congressional support for it. They have wisely hedged by taking places on the Anglo-French Concorde production line. But their early willingness to bet several million dollars on the U.S. entry in the supersonic sweepstakes has served an extremely useful purpose by making it clear to Congress, the President and his executive assistants in the FAA that the proposed product really has a sizable market and significant place in the future of air transport.

Although it has a much lower development price tag, the technical and managerial problems involved in bringing a supersonic transport into successful airline service are nearly as complex and difficult as those facing the Apollo lunar landing program. It would be a great mistake to under-estimate the difficulties facing the supersonic transport program. It would be a mistake of equal magnitude to let these difficulties divert this country from tackling the job with all of the technical, managerial and fiscal resources it can marshal.

President Kennedy found his proposal for a joint U.S.-USSR lunar landing program about equally unpopular in both countries, and apparently was surprised by the vehemence of his domestic critics of the project. The Russians also made it clear that they are indeed racing to the moon, thus dispelling some of the fog generated by the sage of Jodrell Bank, Sir Bernard Lovell, that temporarily convinced some people in high places that the Soviets lacked both the capability and intent to land men on the moon. Since the Soviets found the huge radio telescope over which he presides useful in tracking their deep space probes, they have also found an additional use for Sir Bernard as an international disseminator of their ever-shifting propaganda lines.

Executive Irresponsibility

Although much of the legislative damage wrought by the President's hastily conceived proposal has been repaired by frantic party whip-cracking, most of the space program's staunchest supporters are still shocked by this display of executive irresponsibility toward one of the key programs on which the incumbent Administration must face the electorate next fall.

The top management of NASA has apparently learned little from its heavy rebuffs by Congress on the current appropriations bill and shows no inclination to pare its non-essential activities to save the critical funds for its main technical programs.

However, mingled with satisfaction that both of these key programs are again gaining momentum and support is disappointment that this country did not initiate either venture, but was pushed into them somewhat reluctantly by the spur of foreign competition. It is thus U.S. unwillingness to take the lead in exploring bold new frontiers that is at the root of many of its problems in facing the future. In retrospect, it is evident that only our reluctant reaction to the Soviet threats posed by the possibilities of first a "bomber gap" and then a "missile gap" was responsible for development of the superior military strength we have today. Too many of our leaders pay only lip-service to the idea of leadership and are reluctant to probe the future with much vigor until it becomes painfully necessary for survival.

Because of our superior technical industrial and managerial resources, we have so far managed to come from behind in most of the critical technical races of the post war era.

But in an age when the possibility of technical surprise lurks behind every laboratory door it is becoming an increasingly dangerous method of charting the course of a great nation.

—Robert Hotz

WHO'S WHERE

In the Front Office

Kenneth E. Hunter, president and chief executive officer Hycon Mfg. Co., Monrovia, Calif., succeeding the late **Trevor Gardner** (AW Oct. 7, p. 37). **William Piper**, Hycon's secretary-treasurer, elected a director to fill the vacancy on the board.

Paul R. Holmes, a vice president Aerojet General Corp., he continues as manager of the Downey (Calif.) Plant.

Guy C. Shafer, president and chief executive officer, Chandler Evans Corp., West Hartford, Conn., succeeding **Sidney A. Stewart**, now chairman.

Arthur A. F. Aschauer, executive assistant to the senior vice president marketing, Univac Div. of Sperry Rand Corp., New York, N. Y.

Dr. John L. Gogsby, vice president-engineering, Applied Technology, Inc., Palo Alto, Calif.

Dr. Lester M. Field, vice president research, Hughes Aircraft Co., Culver City, Calif. Also **Edwin P. Ramsey**, vice president-Far East Area, Hughes Aircraft International Service Co., with offices in Tokyo.

Joseph M. DeStefano and **Frank L. Schulte**, vice presidents, Data Sensors, Inc., Gardena, Calif.

Herbert M. Johnson, vice president-engineering, Edo (Canada) Ltd., Cornwall, Ontario, succeeding **Robert A. Lapetina**, appointed president of Electro-Ceramics, Inc., Salt Lake City, Utah, succeeding **Richard D. Hess**, now board chairman. Both companies are subsidiaries of Edo Corp.

James H. McGarry, vice president-manufacturing, ITT Federal Laboratories, Nutley, N. J., a division of International Telephone and Telegraph Corp.

Col. Nicholas S. de Tolly (USAF, ret.) has joined The Boeing Co. as staff assistant to **W. Jerome Kane**, Boeing director of international operations and vice president-general manager of Boeing International Corp.

Changes

Ormon E. (Sam) Bassett, general manager of engineering, Avco Corp.'s Electronics Div., Cincinnati, Ohio, succeeding **H. L. Flowers**, resigned. Also **Stephen D. Moxley, Jr.**, engineering manager of the division's Huntsville (Ala.) Facility.

Edward J. Rapetti, director of government marketing, American Bosch Arma Corp., Garden City, N. Y.

Don E. Rogers, senior staff engineer to the vice president and general manager, Engineering Div., San Bernardino (Calif.) Operations of Aerospace Corp. Also **Bertrand R. Bertaudo**, director system studies, and **Robert D. Waldo**, director defense systems studies, Advanced Planning Div. of the San Bernardino Operations.

Richard H. Curtis, appointed acting director of the Aerospace Industries Assn.'s Vertical Lift Aircraft Council, succeeding **Don Ryan Mockler**, retiring.

Dr. Thomas C. Hall, director-advanced device development, Semiconductor Div. of Hoffman Electronics Corp., El Monte, Calif.

Paul I. Grosber, contracts manager, Space Ordnance Systems, Inc., El Segundo, Calif.

INDUSTRY OBSERVER

► Watch for the British government to release drawings and specifications of the ultra secret TSR 2 strike reconnaissance aircraft this week or next. The decision to do so will be primarily political since the TSR 2 will be a major issue in the coming elections for Parliament. TSR 2 is due for rollout soon at Vickers Armstrongs' Weybridge plant anyway, and, since the hangar doors can be seen from the road, the government feels security cannot be kept much longer. Aircraft is due to fly in February, nearly a year after the original flight date, due to weight and component difficulties.

► **Air Force is considering the feasibility of using aircraft as launching platforms for devices to intercept intercontinental ballistic missiles during the boost phase. Interest in the use of satellites for ballistic missile intercept under the Project Bambi extended study effort apparently has waned.**

► Army Missile Command is projecting an advanced air defense system in which development of a high performance solid rocket motor will be a key consideration. Industry bidders will submit proposals to AMC early next month for R&D efforts in connection with the motor.

► **Boeing is projecting plans for an advanced ICBM to supersede the present silo-based Minuteman. Effort is in keeping with interest of military planners in ballistic configurations with capabilities well beyond that of the improved version of the Minuteman scheduled for final wing deployment. AFSC's Ballistic Systems Div. already has prepared general data for various approaches to an advanced Minuteman system.**

► Indian government is attempting to increase the production rate and the number of Hindustan Aircraft, Ltd., HF 24 supersonic jet fighters to be built. Move comes after the Indians have experienced difficulties with the MiG-21 turbojet fighters obtained from the Soviet Union. Early models of the HF-24 will have two Bristol-Siddeley Orpheus 703 engines.

► **NASA's Nova vehicle is expected now to be a recoverable two-stage liquid propellant system which could not be operational before 1975. Future of the program may not be firm for at least two years.**

► Delay in announcement of the selection of Rolls-Royce to supply its Medway by-pass engine derivative as a powerplant for the Hawker Siddeley AW 681 V/STOL transport (AW Sept. 23, p. 40) is due to reassessment of all funded British defense projects by a Ministry of Defense committee. Also being studied is the Bristol T 188 stainless steel research aircraft.

► **First of two Japanese communications satellite ground terminals is scheduled to become operational within several weeks and the second by early 1964, to provide the first transpacific communication satellite service.**

► Third North American YAT 28E turboprop counter-insurgency aircraft now is scheduled to be built for Aeronautical Systems Div. of USAF's Systems Command. First aircraft crashed during a test flight in March (AW Apr. 1, p. 31). Second aircraft ordered several weeks ago, and the third will have strengthened tail sections and ejection seats.

► **Requests for proposals in the Navy BuWeps program for the program definition phase of the Condor air-to-ground missile probably won't be issued before the end of November.**

► At least two contracts are expected to be awarded for the feasibility study of the low-altitude manned penetrator aircraft designated AMP (AW Oct. 7, p. 23). The aircraft's operational altitude will be about 500 ft., which is expected to require the use of a terrain-avoidance radar, a forward-searching radar and a high-resolution radar for ground mapping. Three month studies under the contracts are expected to be completed by Feb. 3, 1964. Contracts probably will be the fixed price type.

► **Strong possibility exists that solid motors may be used as auxiliary propulsion units for various Saturn configurations to boost payload capacity as well as compensating for any unrecoverable weight increases in Saturn stages.**

Washington Roundup

Kennedy-Vinson Clash

House Armed Services Committee is on another collision course with President Kennedy because of dissatisfaction with the way Defense Secretary Robert S. McNamara is running his department.

Unlike the recent B-70 fight, which was settled amicably when Committee Chairman Carl Vinson and President Kennedy met in the White House rose garden, this battle is a clear matter of principle with no confusing technical considerations.

Rep. Vinson is pushing legislation through the House which would set the terms of all members of the Joint Chiefs of Staff at four years instead of the customary two for the Air Force, Navy and Army chiefs. The Marine Corps commandant already has a four-year term. The President still could remove the chiefs at any time under the bill.

Backers of the bill contend the four-year term would make the chiefs less inhibited when asked by Congress to express their own views on military issues. The lawmakers contend the failure of President Kennedy to reappoint Adm. George W. Anderson to another two-year term as chief of Naval operations and the reappointment of Gen. Curtis E. LeMay to only a one-year term as Air Force chief of staff amounted to punishing them for opposing McNamara.

Members of the House Armed Services Subcommittee, during hearings on the bill last week, bluntly told Deputy Defense Secretary Roswell L. Gilpatric that the measure was a "reaction" to the dictatorial way McNamara was handling the joint chiefs. Rep. Leslie Arends, ranking Republican on the full committee, said "it is not so much what the joint chiefs tell us as what they don't tell us." He said he was supporting the bill to assure "an independent military body."

Gilpatric said the Administration opposed the measure because it would reduce the President's flexibility in dealing with the joint chiefs. He said presidential removal of a chief before his four year term expired would carry a stigma far more damaging than failure of reappointment. He denied that the chiefs are inhibited under the present system.

Rep. Vinson and his colleagues on the armed services committee will continue to push the bill through Congress despite the threat of a presidential veto. The bill is providing a forum for Congress and military officers to challenge McNamara's stewardship of the Defense Dept.

B-70 Outlook Dismal

Defense Dept. officials are now expressing doubt whether the USAF-North American XB-70A Mach 3 aircraft will ever fly, but they do not explain whether they base this conclusion on insurmountable technical difficulties or financial starvation. As of last week, wings had not yet been mated to the fuselage of the first aircraft because of fuel tank leaks and wing misalignment. Air Force announced in August the rollout would be late this year. Slippage of the rollout and first flight dates into next year and slow financial starvation were forecast last spring by AVIATION WEEK & SPACE TECHNOLOGY (May 13, p. 25). Original first flight date was December, 1962.

Now it appears that the rollout will slip well into next year with a first flight next spring. Aircraft numbers two and three are supposed to follow at nine-month intervals.

Slayton's New Role

Donald K. Slayton, who resigned his commission as an Air Force major effective Nov. 20 to supervise astronaut activities as a space agency civilian (AW Feb. 25, p. 25), was chairman of the selection board that picked the third group of astronauts, the last until 1965.

The new group of 14 astronauts includes a PhD and another who is working toward it. The group is younger and better-educated than the 16 astronauts now on the rolls, and has comparable flying experience. Breakdown of affiliations of the new group: Air Force, seven; Navy, four; Marines, one, and civilians, two.

Watch for the final Project Forecast report to emphasize the need for increased aeronautical and propulsion researeb to support a larger USAF role in providing tactical airpower and large-scale airlift, as well as another generation of manned strategic aircraft for the 1970s. USAF project leaders gave Defense Secretary McNamara a full-scale briefing on Forecast conclusions last week in Los Angeles.

—Washington Staff

McClellan to Press Korth Conflict Probe

Carrier issue disputed as cause of Navy secretary's sudden resignation; other financial dealings eyed.

By George C. Wilson

Washington—Circumstances behind the sudden resignation of Navy Secretary Fred Korth are plunging the F-111 (TFX) contract award into its hottest political controversy to date as the McClellan subcommittee and other lawmakers concentrate on the conflict of interest issue.

Congressional sources told AVIATION WEEK & SPACE TECHNOLOGY that disclosures to come during Senate Permanent Investigations Subcommittee hearings, which resume soon, could be as embarrassing to the Kennedy Administration as the activities of the late Harold E. Talbott, former Air Force secretary, were to the Eisenhower Administration.

Investigating subcommittee Chairman John L. McClellan (D-Ark.) plans to go ahead with his examination of Korth's activities despite the Navy secretary's resignation Oct. 11. His staff investigators have been gathering material about Korth for the past several weeks. Sen. Karl T. Curtis (R-Neb.), a subcommittee member, said he will insist that Korth be called as a witness.

Among the information uncovered and now in the subcommittee files is a suit filed in 1961 in the U.S. District Court in Dallas, Tex., charging Korth and several others with fraudulent stock activities. The civil suit was filed by a group of stockholders in a life insurance firm organized in July, 1955, as the All States Life Insurance Co. The firm since has been renamed the Professional and Business Men's Insurance Co. Korth was a director of the insurance company.

The stockholders charged that Korth and others "entered into a conspiracy" to manipulate stock, "and have wrongfully, unlawfully, fraudulently, maliciously and unjustly enriched themselves and obtained huge and unconscionable profits to themselves." Korth's life insurance firm had dealings with BenJack Cage, a convicted embezzler who once had fled to Brazil.

The suit alleged that Korth was one of the "insiders" who, during the organization of the life insurance firm, received 50,000 shares of stock at 20 cents a share and later re-sold 3,500 shares to other stockholders at $5.25 a share for a profit of $13,709.50. The suit charged that Korth and his associates broke several laws in handling the firm's stock, including placement of misleading information in the prospectus.

The latest complaint in the suit was filed in District Court in Dallas on June 26, 1962. The suit, which asked $5 million, was settled out of court on May 15, 1963. Korth and his fellow defendants agreed to surrender 120,000 shares of stock worth nearly $1 million. Korth became Navy Secretary Jan. 3, 1963.

The court suit and other information the subcommittee has uncovered about Korth's dealings before and after he became Navy secretary, including new information about the relations between General Dynamics/Ft. Worth and the bank Korth headed in that city, has made several members of the subcommittee more determined than ever to pursue the conflict-of-interest question.

When Korth testified before the McClellan subcommittee on his role in the F-111 competition, he heatedly denied insinuations that his Ft. Worth connections could prejudice him in favor of General Dynamics, winner of the F-111 tactical fighter award.

"I am a man of integrity," Korth said heatedly. "If you find or this committee finds that I am not, certainly you should so recommend to the President and I will promptly hand in my resignation" (AW July 29, p. 18).

Rep. Bill Stinson of Bellevue, Wash.—where Boeing, the loser of the F-111 tactical fighter contract, is located—was one of the few lawmakers who publicly attributed Korth's resignation to the F-111 controversy. He suggested the conflict of interest question was the real reason. "Since he offered to resign if the subcommittee found substantial evidence of conflict-of-interest," Rep. Stinson told AVIATION WEEK & SPACE TECHNOLOGY, "perhaps he has now determined there is substantial evidence of this and that is why he is resigning."

The Washington Republican was also among those members of Congress who rejected the theory, circulated by Navy leaders, that Korth resigned because he could not persuade Defense Secretary Robert S. McNamara to build a nuclear rather than conventionally powered aircraft carrier (see p. 27). Rep. Stinson called this a "strange reason," asserting that it amounts to saying: "You play the game my way or I'll pick up my marbles and go home."

Rep. Jim Wright (D-Tex.) of Ft. Worth, who is a staunch backer of Korth and of his F-111 decision, blamed the rough treatment Korth received from the McClellan subcommittee for the Navy secretary's resignation. He said congressional appropriation of money for the F-111 in its fiscal 1964 appropriation bill "is in itself complete vindication and a total vote of confidence in the stand taken by Secretary Korth. . . . I think that when any human being is subjected to the harassment that has been directed at Secretary Korth, even the most dedicated man could easily reach the point where he feels that continuing in his post is simply no longer worth the abuse."

A Democratic senator on the McClellan subcommittee dismissed the carrier story as "a cover" for the real reason, predicting that this story will not stand up once the F-111 hearings focus on the conflict-of-interest issue late this month. Republican Sens. Karl E. Mundt (S.D.) and Carl T. Curtis (Neb.) will explore the conflict-of-interest possibilities when the hearings resume. Subcommittee investigators have spent considerable time in Ft. Worth recently tracing dealings between the Continental National Bank, which Korth headed before becoming Navy secretary, and General Dynamics. Korth has rejected all implications that the loan could have influenced his decision to recommend General Dynamics for the F-111 contract. He said Continental participated "in a small way" in a loan to General Dynamics negotiated by the Chase Manhattan Bank.

The McClellan subcommittee is expected to discuss additional bank operations where Korth's role could give the type of conflict of interest appearance the Supreme Court warned against in its Dixon-Yates decision. The court in that decision said the conflict-of-interest law was "directed not only at dishonor, but also at conduct that tempts dishonor. This broad proscription embodies a recognition of the fact that an impairment of impartial judgment can occur in even the most well-meaning men when their personal economic interests are affected by the business they transact on behalf of the government. To this extent, therefore, the statute is more concerned with what might have happened in a given situation than with what actually happened" (AW Sept. 9, p. 28).

President Kennedy's own 1961 standards of conduct stress the same theme, declaring: "Even though a technical conflict of interest . . . may not exist, it is desirable to avoid the appearance of such a conflict from a public confidence point of view."

Assistant Attorney General Norbert A. Schlei last month wrote Rep. Stinson that the Justice Dept. investigated Korth's role in the F-111 selection from a conflict-of-interest standpoint "and has determined that there was no violation of the statute by Secretary Korth." On Sept. 27, Rep. Stinson replied in a letter to Attorney General Kennedy that Schlei "did not give an explanation of how you arrived at your decision." He asked whether the Justice Dept. had investigated the Continental National Bank and requested a conference with Justice Dept. and representatives of the McClellan subcommittee. Rep. Stinson had not received a reply to his letter as of late last week.

In his Oct. 11 letter of resignation to President Kennedy, Korth said he was leaving effective Nov. 1 "so that I may return to private business and attend to my pressing private affairs." Although Korth himself did not go beyond this, Navy spokesmen, with his apparent approval, said McNamara's refusal to build the nuclear carrier was the main reason he quit. However, Korth quit before the final decision on the carrier issue was made. A Navy official, speaking for Korth, gave this sequence:

- **Oct. 9.** McNamara notified Korth he intended to direct the Navy to make its new carrier conventionally powered.
- **Oct. 10.** Korth sent a two page letter to McNamara listing points he wished to discuss in hopes of changing the tentative decision.
- **Oct. 11.** Korth and McNamara breakfasted in the latter's dining room and discussed the carrier question from 7:30 a.m. to 8:30 a.m. At 9 a.m., Korth met in his office with his policy council—top advisers—to discuss the carrier question. That afternoon Korth discussed the same questions with Adm. Hyman Rickover and Adm. David L. McDonald, chief of Naval operations. This same day, Korth wrote his letter of resignation.
- **Oct. 12.** Korth and Adm. McDonald met with McNamara in the latter's office at 11 a.m. for another conference on the carrier.
- **Oct. 14.** Korth entered the Bethesda Naval Hospital for an ear operation. He was reported as recovering successfully last week. The White House announced his resignation.

Deputy Defense Secretary Roswell L. Gilpatric on Oct. 16 told AVIATION WEEK & SPACE TECHNOLOGY that the final carrier decision had not been made and said he presumed Korth would have another chance to argue his case. So both the Navy's chronology of events and Gilpatric's statement put Korth's resignation of Oct. 11 well before the carrier battle was over.

Paule Nitze, assistant secretary of defense for international security affairs, will succeed Korth as Navy secretary while William P. Bundy, deputy assistant secretary of defense for international security affairs, will advance to Nitze's post.

NOSS Study Bids Submitted

Los Angeles—Bids were submitted last week to USAF's Space Systems Div. in the competition for the national orbiting space station (NOSS) study (AW Sept. 16, p. 26).

Approximately 45 potential bidders were briefed on the general requirements for the study. Proposals were due 30 days after issuance of the official request. The following firms were scheduled to submit proposals. In team submissions, the first company named is prime.

- Lockheed Missiles & Space Co. and Lockheed-California Co.
- North American Space & Information Systems Div., Hughes Aircraft Co. and Honeywell Military Products Group.
- Boeing, Honeywell Military Products Group, Litton and Philco.
- Douglas Aircraft Missile & Space Systems Div. and International Business Machines Corp.
- Aerojet-General, Radio Corp. of America, Burroughs and Lovelace Foundation.
- General Electric, Republic Aviation Corp. and General Precision, Inc.
- Space Technology Laboratories and Grumman Aircraft Engineering Corp.
- Martin Co., General Precision Aerospace Group, Raytheon Co., Bendix and Eastman Kodak Co.
- General Dynamics/Astronautics.

Decision for Conventional Carrier Is Tentative

Washington—Defense Secretary Robert S. McNamara has tentatively decided to approve a conventionally powered aircraft carrier because he believes this type of ship will be more readily accepted by Congress than one powered by nuclear reactors. However, he is ready to change his decision if the sentiment of Congress leans toward a nuclear carrier.

The issue of nuclear vs. conventional power for the next Navy carrier, consequently, had not yet reached a head at the time of Navy Secretary Fred Korth's resignation (see p. 26). McNamara's failure to come to a strong conclusion is based primarily on Navy cost effectiveness studies which have been inconclusive and favor neither conventional nor nuclear propulsion.

Top Defense Dept. officials believe that Armed Service committees, both House and Senate, are against nuclear power. However, Sen. John O. Pastore, (D-R.I.), chairman of the Joint Congressional Atomic Energy Committee, questions this decision and has announced that he will hold hearings on the subject.

A Defense Dept. official told Aviation Week & Space Technology that the Navy study on nuclear power made last spring (AW May 6, p. 35) and other Defense Dept. studies show no clear advantage for either system. He said, however, it is desirable to reduce the complexity of ships, and nuclear power only adds to the complexity.

Added to the inconclusive studies is the position of Adm. David L. McDonald, chief of naval operations, who was not strongly for or against nuclear power. Korth was reported by official sources to have been a strong advocate of the use of nuclear power.

As of last week, funds had not been released to the Navy to begin work on the carrier, which will be of the heavy attack type and designated CVA-67. Funds for this carrier were appropriated in Fiscal 1963, and it is expected that McNamara will continue to withhold the money until Congress expresses its preference for either conventional or nuclear propulsion.

Meanwhile, Navy will be told to phase out its older Essex class attack carriers into the anti-submarine force.

In announcing his hearings, for which no date has been set, Sen. Pastore said: "Testimony received by the Joint Committee in the past and in hearings held aboard the nuclear carrier USS Enterprise on Mar. 3, 1962, indicate that the military performance of a nuclear carrier is far superior to conventional ships. If only economic factors were the basis for deciding the types of ships the Navy will have, then it would not have converted from sail to coal-burning and then from coal-burning to oil."

Vice Adm. Hyman G. Rickover, assistant chief of the Bureau of Ships for nuclear propulsion, is the leader in the Navy's internal fight for nuclear power. Many other top officers do not care which type of power is used as long as the Navy can replace its obsolescent ships. For this reason, the Navy does not have a united position and is unable to present a strong case for nuclear power.

Soviet Lunar Plans Helping NASA Cause

By Alfred P. Ahlbrando

Washington—Official Soviet acknowledgment that the USSR is planning a manned lunar landing mission before the end of the decade strengthened pleas of space officials last week for Senate restoration of $250 million cut by the House from the National Aeronautics and Space Administration's Fiscal 1964 budget.

Though Russian officials have made many references to preparation for manned lunar landing missions, their statements have been vague and conflicting. On Oct. 15 in New York, Anatoli Dobrynin, Soviet ambassador to the U.S. said unequivocally that Russia is planning to land men on the moon by 1970.

Russia's intentions became more mysterious last summer when Sir Bernard Lovell, director of Britain's Jodrell Bank Observatory, said after a visit to the USSR that the Soviet Union had no intention of going to the moon and intended instead to approach the U.S. on a joint program (AW July 22, p. 323).

Last week, Soviet Cosmonaut Yuri Gagarin answered a question on whether Russia has a manned lunar program with, "of course." Asked when the first Russian would land on the moon, Dobrynin said, "by the end of this decade."

Neither Dobrynin nor Gagarin amplified their statements on the Soviet manned lunar landing program.

NASA Administrator James E. Webb was prepared to tell the Senate Appropriations subcommittee on independent offices last week that the agency must have an appropriation of at least $5.35 billion for Fiscal 1964 to keep the manned flight program on schedule. Webb had warned earlier that the $5.1 billion voted by the House would mean a stretch-out of the manned lunar landing program beyond the present target—1968-69—and increase total costs.

If the final NASA budget approved by Congress is less than $5.35 billion, the agency almost will certainly ask for a supplemental appropriation early next year. In addition, the NASA appropriation this year will largely determine NASA's budget request for Fiscal 1965. If the agency receives $5.35 billion for Fiscal 1964, the Administration will submit a space budget request of about $5.6 billion for Fiscal 1965.

Administration's original request for Fiscal 1964 was $5.72 billion. Congress authorized $5.35 billion and the House on Oct. 10 voted the $5.1-billion appropriation measure.

Senate Appropriations Committee is expected to recommend a NASA appropriation of $5.3-$5.35 billion, and to strike out the House prohibition against use of any Fiscal 1964 funds for U.S. participation with the Soviet Union in a joint lunar landing program.

It was evident shortly after President Kennedy's UN proposal for a joint U.S.-Soviet Union manned lunar landing program that the proposal would be used by opponents of the space program as an argument for cutting NASA's budget.

First attack came in the House Appropriations subcommittee on independent offices where at one point the members split 4-4 on a move to cut the NASA appropriation to $4.2 billion (AW Oct. 7, p. 29). After the tie vote, Rep. Thomas and Administration officials worked feverishly to gather support for a minimum appropriation of $5.1 billion.

While Rep. Thomas succeeded during the week of Sept. 30 in holding off the space budget cutters—including his own committee chairman, Rep. Clarence Cannon (D.-Mo.)—House Speaker John McCormack (D.-Mass.) made a very special effort to line up party support for the NASA appropriation.

The House Appropriations Committee received the $5.1 billion NASA appropriation bill from the subcommittee on Oct. 7, approved it and sent the measure on to the House floor, where it was passed Oct. 10 (AW Oct. 14, p. 37).

Both Democrats and Republicans attacked the NASA appropriations in the long and lively floor debate.

Rep. Cannon said that while he supported the entire independent offices bill, he was opposed to the manned lunar landing program.

"If there were any prospects of achieving anything of real scientific or military value, the proposition might be open to consideration," Rep. Cannon said. "But the most eminent authorities not connected with the various projects tell us that even if we succeed in putting a man on the moon, which is doubtful, or bringing him back again, which is even more doubtful, nothing of value would be added to human knowledge that could not be obtained by robot packages of instruments.

"It is impossible to escape the conviction that the project must eventually be abandoned," he said.

Rep. Howard Smith (D.-Va.), chairman of the House Rules Committee, called the lunar landing program a "fantastic project" and a "moonshine trip." He urged elimination of the program, and said:

"Let us come down to earth . . . we have no invitation to go up there to the moon. If Russia wants to do something foolish, why should we race with them?"

To these criticisms, Rep. George Miller (D.-Calif.), chairman of the House space committee, replied that "you can always criticize those things you do not understand."

Republican opposition was headed by Rep. Louis C. Wyman (R.-N.H.), a member of the House Appropriations independent offices subcommittee. Rep. Wyman said he was opposed to spending in the Apollo program because the nation is "on the verge of national bankruptcy" and because the NASA program does not include development of a space weapons system.

Rep. Olin Teague (D.-Tex.), chairman of the House manned space flight subcommittee, replied that "every single achievement and everything that we learn in going to the moon has a military significance."

Rep. Joseph Karth (D.-Minn.), chairman of the House space sciences subcommittee, said he was "shocked at the lack of understanding of the purposes of research."

He said it is not a matter of physically landing a man on the moon that is so important. "What is important is developing the technology and expertise . . . we live the good life in the U.S. . . . primarily because of the advance of the state of the art, the basic and applied research and the exhaustive development processes we have gone through for many, many years in many different disciplines."

Rep. Wyman's attempts to cut the NASA appropriation were defeated. He first offered an amendment which would have slashed $700 million from the appropriation—$550 million from the Apollo program and $150 million from unmanned lunar and planetary projects. This amendment was defeated 132-47, shortly after four Project Mercury Astronauts—Marine Lt. Col. John Glenn, Jr., Navy Cdr. Alan Sheppard, USAF Maj. Virgil I. Grissom and Navy Lt. Cdr. Scott Carpenter—entered the chamber.

Rep. Wyman's motion to have the bill recommitted to the House Appropriations Committee with instructions to cut back to $4.9 billion was defeated, 192-145, and the House went on to approve the independent offices money bill by a vote of 302-32.

The measure as approved, however, contained a prohibition against using any of the Fiscal 1964 appropriation for "participating in a manned lunar landing to be carried out jointly by the U.S. and any Communist Communist-controlled or Communist-dominated country." The vote on the amendment, offered by Rep. Thomas Pelly (R.-Wash.), was 99-93. The Democratic leadership made no great attempt to defeat the amendment.

NASA and the Administration won a victory of sorts when the House defeated, in a voice vote, an amendment by Rep. John Wydler (R.-N.Y.) which would have forbidden the expenditure of $3.9 million authorized for start of work on a new Electronics Research Center which will be located in the Boston area.

The $13 billion independent offices appropriation bill voted by the House also included:

- **National Science Foundation**, $323.2 million, a cut of $265.8 million in the amount requested.
- **Office of Science and Technology**, $780,000, a reduction of $245,000.
- **National Aeronautics and Space Council** $525,000, the full amount requested.

Apollo Landing Test

Los Angeles — Critical test for the Apollo spacecraft landing system was scheduled late last week at El Centro, Calif., in preparation for the boilerplate Apollo pad abort test to be conducted at White Sands, N.M., next month.

In the El Centro test, an Apollo boilerplate unit was to be dropped from a C-133 at about 25,000 ft. The first chute opening was to turn the Apollo capsule so that the heat shield end would be up, to simulate an unfavorable re-entry.

Subsequent action of a drogue chute was intended to right the capsule at about 10,000 ft. so that the heat shield would face down, to be followed by deployment of three pilot chutes and then three main chutes.

Northrop Ventura Div. is designer and developer of the landing system.

Mars Probe Failure

Washington—Soviet Mars 1 probe lost contact with earth tracking stations at a distance of 65 million mi. because of a malfunction in the spacecraft attitude control system, Alexandre A. Mironov, Soviet Embassy scientific adviser, said here last week.

Mars 1 was launched on its 142-million mi. mission on Nov. 1, 1962 (AW Nov. 5, 1962, p. 43).

Gemini Flight Is Still Scheduled For 1963 Despite Many Problems

Washington—National Aeronautics and Space Administration continues to experience development problems in the Gemini program, but the agency maintains it will meet its announced schedule of flying a manned Gemini mission before the end of 1964.

First unmanned orbital Gemini flight is still on the Atlantic Missile Range schedule for mid-December, but chances are growing slim that this date will be met. The flight is designed to validate the Martin Titan 2 launch vehicle and the McDonnell Gemini capsule configuration.

Gemini capsule No. 1 is an instrumented boilerplate, and has been undergoing tests at Cape Canaveral since its delivery Oct. 4 (AW Oct. 7, p. 23). The Titan launch vehicle is scheduled to be shipped to the Cape Oct. 23 or 24.

Although both capsule and launch vehicle must undergo extensive testing, both separately for systems qualification and mated for compatibility, the outlook for a 1963 Gemini launch is dim more because of an administrative event—the range closes down for two or three weeks in mid-December for crew vacations and maintenance.

Titan 2 Airlift

The Titan 2 was to be airlifted to AMR from the Martin Baltimore plant this week. After arrival, this vehicle will undergo a number of static firing and sequence tests before the stages are assembled.

The second Gemini launch vehicle is now being assembled at the Baltimore plant.

NASA recently ordered another Gemini boilerplate capsule to use as a backup to the first mission, since it was the only mission in the development program without a backup. Like capsule No. 1, it will be heavily instrumented and will be designed to validate the Titan-Gemini configuration. It will not be flown if the first mission is successful.

Officials close to the Gemini project will not list specific problem areas which are pacing the Gemini schedule. The NASA position is that all systems are pacing and not one has progressed to the point where its development can be termed outstanding.

Asked if any part of the program is on schedule, one official answered, "The astronauts."

The optimism that manned flight can be made next year stems from development activity during the past summer and early fall, when problem areas were isolated and fixes proposed. Various solutions for these problems are being tried at this time (see box).

One major problem area that has been in the open is the paraglider recovery and landing system. This system has experienced considerable development difficulty (AW July 22, p. 175), and there were industry reports here last week that NASA has given up on the paraglider for Gemini and will use parachutes on all flights.

Parachutes Planned

NASA said however, that the paraglider is not out, but that the agency has decided to wait an unspecified period before deciding in which capsules it will be incorporated. Initially, the paraglider was to have gone into capsule No. 3, the first to carry pilots. This capsule, and probably at least several more, will now use parachutes and land in the water.

Development of skids for a ground landing is not a problem. The difficulty is in stowage and deployment of the paraglider system. NASA recently requested contractors to bid on studies for concepts, development and modes of sea retrieval equipment for both Gemini and Apollo.

Primary recovery area for Apollo will be Texas, but this system will use parachutes for letdown and a retrorocket for landing shock attenuation. Gemini can not make a ground landing with parachute because it has no shock attenuation system.

Titan 2 'Pogo' Fixes

Fixes to eliminate the "Pogo effect," an 11-cps longitudinal oscillation in Titan 2 boost vehicles for NASA's two-man Gemini capsule, will be evaluated in three research and development type Titan 2 ballistic missiles to be launched by Air Force Systems Command's Ballistic Systems Div.

The fixes include an increase in fuel tank pressure and installation of a mechanical accumulator and a standpipe. If the fixes are successful in missile flights they will be incorporated in the Titan 2 launch vehicles for Gemini.

Gemini will be launched by a modified Titan 2 vehicle to evaluate the capsule shell structure, its aerodynamic characteristics and general compatibility with the booster. The Titan 2 booster to be used for this experiment is scheduled to come off the Martin Co.'s Baltimore Div. production line and be delivered to Cape Canaveral this week.

NASA, DOD Agree on Space Station

Washington—Defense Dept and National Aeronautics and Space Administration last week agreed to coordinate their growing space station study efforts, and at the same time laid the groundwork for the President to decide if a space station program should be undertaken and who will manage it.

The agreement, signed by Defense Secretary Robert S McNamara and James E. Webb, NASA administrator, provides for coordination of all space station studies through the existing Aeronautics and Astronautics Coordinating Board.

The AACB is to make recommendations to Webb and McNamara, who will advise President Kennedy on the need for a space station program and its management. NASA-Defense Dept differences can be appealed to the President.

If a space station program is approved and management responsibility is determined and assigned a joint NASA-Defense Dept group, similar to the Project Gemini Planning Board, will be formed to establish objectives and select experiments.

NASA is spending more than $2 million on 16 space station studies (AW July 22, p 80) and the Air Force has received bids on three parallel study contracts to be awarded early next year (see p 26) on the national orbiting space station (NOSS).

NASA-Defense Dept. agreement comes as demands from Congress for a military space station program are increasing. With the manned lunar landing program requiring a NASA budget of between $5.5-$6 billion for the next few years, some NASA officials are doubtful that the agency should undertake a space station program concurrently with Apollo.

Air Force, on the other hand, considers the space station as its top priority new space program and is arguing that the nation needs an operational system by 1967.

Agreement reached last week may resolve what steps NASA will take next on its manned orbital research laboratory (MORL) and the Air Force on its NOSS program (AW Oct. 14, p. 25).

C-W Extends Garrett Stock Plan

Curtiss Wright Corp., after failing to acquire all 700,000 shares of common stock it sought in the Garrett Corp., last week extended its offer and raised the net price from $50 to $57 per share.

Curtiss Wright said the offer would be withdrawn Oct. 31 and would not be renewed. Shares offered to Curtiss-Wright since the plan was announced (AW Sept. 16, p. 39) will not be accepted, but owners may take advantage of the higher price, the firm said.

Although a "very sizable number of shares had been tendered under the original offer," Curtiss-Wright acknowledged that the amount "was not large enough to warrant paying the premium price of $50 a share." The total offer to buy 700,000 shares represented about 47% of outstanding Garrett stock.

Garrett has opposed the C-W plan and has sought a federal court order to prevent any stock acquisition.

Curtiss Wright's first offer expired Sept. 27. It was extended to Oct. 11, after which the company had five working days in which to decide a course of action. Company will review its latest position in the five days after Oct. 31.

As a part of its new offer, Curtiss-Wright asked Garrett shareholders interested in selling to sign proxies effective upon acceptance of the sale. Curtiss-Wright said the provision was inserted because Garrett, after first learning of the plan, had moved its annual meeting from Nov. 27 to Nov. 6 "on a transparent pretext."

Garrett had a strong ally in its battle with Curtiss-Wright. One day prior to the termination of the first offer, Signal Oil & Gas Co. of Los Angeles said it had purchased over 100,000 shares of Garrett stock for investment purposes.

Signal, a producer and marketer of petroleum products, is continuing to buy Garrett stock. It holds between 100,000 and 150,000 shares. Signal's purchases were known to Garrett officials, who were reported to have been "very pleased" with Signal's action.

A Garrett spokesman said that Signal's purchase removed those shares from possible sale to C-W. In addition, the announcement that Signal was buying the shares had an important psychological impact on the final day of the offer, he claimed. It is believed that many holders of large blocs of Garrett stock waited until the last day before deciding whether or not to submit shares to C-W.

Prior to the C-W tender, Garrett stock had sold at around $42. During the period of the offer the price on the New York Stock Exchange was between $48 and $50.

Signal's recent purchases probably make it the owner of the second largest bloc of Garrett shares, according to Garrett. Largest single holder is Merrill Lynch, Pierce, Fenner and Smith, which prior to the C-W offer held for itself and its customers about 12% of the 1,494,000 Garrett shares outstanding.

USAF Launches Two Vela Hotel Satellites

Cape Canaveral—Air Force launched a pair of Vela Hotel deep-space nuclear detection satellites here last week after troubles with the Lockheed Agena second stage delayed earlier attempts.

Also included in the payload package was an advanced tetrahedral research satellite, the fourth in a series of small piggyback satellites designed to make radiation measurements.

The two 485-lb satellites, carrying 12 X-ray detectors on the 12 points of their icosahedral shapes, and gamma ray and neutron counters inside their shells, were launched at 9:32 p.m. EST Oct. 16 after four postponements.

The tandem-mounted satellites were programmed for ejection from the Agena at an altitude of about 57,000 mi., the apogee of a highly elliptical orbit. One of the twin satellites then was to fire a small solid-propellant motor contained within the satellite and go into a circular orbit at that altitude. The other satellite was to have made one complete pass in this 200 57,000 mi. elliptical orbit and, as it came back to the apogee point again, it was to have fired its injection motor. As it too went into a circular 57,000-mi. orbit, the other would have moved 180 deg. away.

Large phase difference between the satellites was intended to preclude their reading solar storms and other cosmic phenomena as nuclear explosions.

B-58 Record Flight

Washington—U.S. will claim the non-stop speed record between Tokyo and London as the result of an Air Force-General Dynamics B-58 flight on Oct. 16 in which the 6,028 mi. course was flown in 8 hr. 35 min. at an average speed of 936 mph.

The bomber, commanded by Maj. Sidney G. Kubesch, slowed to subsonic speeds five times to refuel. Other crewmen were Capt. Gerald R. Williamson, defensive systems operator, and Maj. John O. Barrett, navigator. All are assigned to Strategic Air Command.

Two of three B-58s that took off from Kadena AFB, Okinawa, were to make the record attempt, but one developed minor mechanical difficulty and landed at Eilson AFB, Alaska. Another left the record course as planned over Alaska and landed at its home base, Bunker Hill AFB, Ind. Maj. Kubesch's aircraft landed at Newburs.

The existing record, 17 hr. 42 min., was set in 1957 by Great Britain's W. Hoy, who flew the course in an English Electric Canberra at an average speed of 335.7 mph.

B-52 Follow-on Funds May Be Sought in '66

San Diego—First heavy funding for development of a follow-on aircraft to replace the Boeing B-52 might be requested in Fiscal 1966, Under Secretary of the Air Force Brockway McMillan said at a press conference here last week.

McMillan indicated that he expected a follow-on aircraft to be in operation before the final phase-out of the B-52 fleet in 1972. B-52s will be in operation for this nine-year period with natural attrition reducing the size of the fleet, he said. The two types of follow-on aircraft were listed by McMillan as:

- **Large, multi-purpose,** long-endurance aircraft capable of such missions as air defense, airborne control center and missile launching platform. Such an aircraft, commonly referred to as Maple, is now under study by USAF (AW Sept. 16, p. 26).
- **Low-altitude** manned penetrator. Air Force is studying such an aircraft formerly called LAMP and now called AMP, as an advanced manned penetrator (AW Oct. 7, p. 23).

McMillan was a keynote speaker at a symposium on ballistic missile and space technology sponsored by USAF's Space Systems Div. and Ballistic Systems Div.

Ling-Temco-Vought Changes Structure

Dallas, Tex.—Ling-Temco-Vought has reorganized its corporate structure, discontinuing the names of the Chance Vought Corp. and Temco Electronics & Missiles Co., renaming 10 divisions and has given a number of executives new posts and titles.

The changes are not expected to affect the company's traditional areas of work, but are aimed at shortening inter-company lines of communication and reducing costs by eliminating some present administrative duplication, according to James J. Ling, who has assumed the post of chairman of the board while remaining chief executive.

Robert McCulloch, former board chairman, will retain his post as a chairman of the LTV executive committee. McCulloch said he stepped down as board chairman to relinquish day-to-day line responsibilities, but expected to retain an active and participating interest in the company's general business affairs.

Paul Thayer, former president of the Chance Vought Div., was made senior vice president of LTV. He will direct five LTV operating units—LTV Vought Aeronautics, LTV Astronautics, LTV Range Systems, LTV Michigan and Kentron Hawaii.

Ling-Temco-Vought's electronics and commercial divisions will report to Executive Vice President Clyde Skeen, who also serves as chief financial officer. Skeen and Thayer report directly to LTV President and Chief Operating Officer Gifford K. Johnson.

All LTV operations now are grouped into 12 operating units. Each of the five division heads has been promoted to a corporate vice president in addition to being general managers of the newly named division.

These are: E. Fred Buehring, LTV Temco Aerosystems Div.; J. Russell Clark, LTV Astronautics Div.; D. G. Gilmore, LTV Vought Aeronautics Div.; W. R. Kiefer, LTV Michigan Div., and J. O. Weldon, LTV Continental Electronics Div.

Other newly renamed divisions are—LTV Altec, consisting of Altec Lansing and its Peerless Electrical Products Div.; Altec Service Corp. and Gonset, Inc.—Alvis Ward, president; LTV Ling Electronics Div.—Robert Lewis, president; LTV Military Electronics Div.—R. C. Blaylock, president; LTV Range Systems Div.—John McGuyrt, president, and LTV University Div.—Haskel Blair, president.

Two subsidiaries make up the other operating units: the Friedrich companies, R. L. Harrison, president, and Kentron Hawaii, Adrian Perry, president.

Fairchild May Build Turbo-Porter in U. S.

Fairchild Stratos Corp. has signed a license agreement with Pilatus Aircraft Works, Stans, Switzerland, providing for the sale of the Swiss company's Turbo-Porter (AW Dec. 17, p. 92) in the United States. Fairchild currently has one aircraft for demonstration purposes and two Alaska airlines, Wein Alaska and Northern Consolidated, have had the aircraft in service since late 1962. Swiss-built version is powered by a Turbomeca Astazou engine, but other engines may be available if the aircraft goes into production here. The Turbo-Porter is 36 ft. long, has a wing span of 49 ft. 10½ in., a height of 10 ft. 6 in. and a gross weight of 4,320 lb. The aircraft currently is being demonstrated to the U.S. Army.

Space Weapons Ban

United Nations, N.Y.—U.N. Disarmament Committee last week submitted a resolution to the General Assembly calling for a ban on nuclear and any other types of mass-destruction weapons in outer space.

The resolution, also aimed at prohibiting installation of such weapons on celestial bodies, was sponsored by 17 of the 18 nations—including the U.S. and the Soviet Union—represented on the committee. France, the only committee member which boycotted the Geneva disarmament meetings, refused to sponsor the resolution but is expected to vote for it in the General Assembly.

KC-135Fs to Support Mirage 4s

Paris—French air force will take delivery in January on the first of 12 Boeing KC-135F tankers which will be used to improve the nuclear striking capability of its Mirage 4 strategic bombers.

It is expected that the French will get the additional tankers at the rate of one per month, with all 12 aircraft in their hands by 1964. A French tanker crew completed training on the KC-135 last summer in the U. S. Eight additional French air force crews reportedly will have completed similar training in the U. S. by the end of this year.

France's Strategic Air Force, being put together around the Mirage 4 bomber, will operate the tankers. Its transport division also will have call on the tankers, in their transport version, in case of an urgent military transport need.

The French air force also is taking delivery, on schedule, of its first Mirage 4 bombers. Accelerated crew training has been under way on two Mirage 4 prototype bombers. It is expected that the first Mirage 4 squadron will be fully operational by mid 1964.

A plutonium bomb armament for the French strike force has been ready for some time. Similar tactical armament is being readied for the Mirage 3 and Etendard fighters.

Patent Rules Designed to Eliminate Variations in Government Policies

Washington—Aerospace contractors no longer will find such wide variations in the patent policies of National Aeronautics and Space Administration and the Defense Dept. if the recent policy guidelines issued by President Kennedy produce the intended effect.

In issuing the guidelines Oct. 10, President Kennedy said, "it is not feasible to have complete uniformity of practice" in deciding whether the contractor or the government should take title to inventions made under federal contracts, but said "there is need for greater consistency in agency practices."

The guidelines attempt to protect the interest of the government and public without denying contractors the chance to exploit commercially those inventions they made largely because of their own special competence in a given field. The impact of this broad objective will not be felt until the federal agencies actually write patent clauses into new contracts and make some case decisions on patent rights. Existing contracts will not be affected.

The policy guidelines state that the government "shall normally acquire" title or principal rights to inventions made under federal contracts when:

- "A principal purpose of the contract is to create, develop or improve products, processes or methods which are intended for commercial use (or which are otherwise intended to be made available for use) by the general public at home or abroad."
- "A principal purpose of the contract is for exploration into fields which directly concern the public health or public welfare."
- "The contract is in a field of science or technology in which there has been little significant experience outside of work funded by the government, or where the government has been the principal developer of the field, and the acquisition of exclusive rights at the time of contracting might confer on the contractor a preferred or dominant position."
- "The services of the contractor are for the operation of a government-owned research or production facility or for coordinating and directing the work of others."

However, the head of an agency or department could give the contractor special rights as "a necessary incentive to call forth private risk capital and expense to bring the invention to the point of practical application." The guidelines put the burden of proof on the administrator that such special rights would be in the public interest. This new policy contrasts with current Defense Dept. policy, which normally lets the contractor keep title to inventions. NASA normally does the opposite by keeping title to its contractors' inventions. NASA officials have complained in the past that this policy difference makes it easier for DOD to attract contractors for research projects.

The new policy guidelines state that the contractor "shall normally acquire" title or principal rights to inventions "where the purpose of the contract is to build upon existing knowledge or technology to develop information, products, processes or methods for use by the government, and the work called for by the contract is in a field of technology in which the contractor has acquired technical competence (demonstrated by factors such as know-how, experience and patent position) directly related to an area in which the contractor has an established non-governmental commercial position." The government in this and all other cases would still insist on at least an irrevocable, non-exclusive royalty-free license.

Even if the technical competence of the contractor did not fit the above description, the agency could still grant him title to the invention or other special rights if it determined this would best serve the public interest.

Any contractor granted exclusive or special rights to an invention must develop it "to the point of practical application" within three years or face the possibility of the government licensing someone else to market it. The government also could license more than one contractor if the public interest demanded a wider base of production.

In cases where the government took the principal U. S. rights to an invention but not the foreign ones, the contractor could be given foreign rights as long as this did not conflict with treaties.

The guidelines say: "Government-owned patents shall be made available and the technological advances covered thereby brought into being in the shortest time possible through dedication or licensing and shall be listed in official government publications or otherwise."

New Mooney Mark 22

Kerrville, Tex.—Plans to deliver a four-place, pressurized, 250-mph. single-engine aircraft to customers in 1965 were disclosed here at Mooney Aircraft, Inc.'s 1964 dealers and distributors meeting last week.

Company also disclosed plans for a more powerful, faster version of its present Mark 21 four-place aircraft.

Hard tooling already has been built for many components of the Mark 22 pressurized aircraft, and partial mockups of the fuselage have been built. A prototype is scheduled to begin flight tests in October, 1964. The aircraft will be powered by a new six-cylinder, 290-hp. Lycoming engine. Price of the Mark 22 is planned to be less than $39,000.

Mooney's Super Mark 21 has a 200-hp. Lycoming fuel injection engine, which increases horsepower available by 20 over the present Mark 21 and adds about 12 mph. speed. Price for the standard Super Mark 21 will be $18,450, compared with $16,450 for the present Mark 21.

Mooney also produces the fixed-gear Mark 20D Master which sells for $13,995, and will assemble the Mitsubishi MU-2 turboprop executive aircraft (AW Aug. 26, p. 98).

CX-4 HEAVY LOGISTICS transport design developed by Douglas is shown in artist's concept.

CX-4 Concept Has Swing-Nose, Aft Ramp

By C. M. Plattner

Los Angeles—Douglas Aircraft Co.'s concept of the proposed CX-4 heavy logistics transport calls for a six-engine airplane with a swing nose and aft ramp, permitting simultaneous loading or unloading at both points.

Once viewed primarily as a replacement aircraft (for the Douglas C-133), the CX-4 design's basic mission now is conceived as providing airlift capability for speedy global deployment of U. S.-based Army troops and equipment. The design provides a capability for airlifting complete Army divisions, including outsize equipment.

Growing pressure from congressional and military sources is being directed toward development of increased airlift capability (AW Sept. 30, p. 25) for this purpose.

Indications of Defense Dept. interest in the CX-4 came last week when under-secretary of the Air Force Brockway McMillan said in San Diego that DOD now looks with favor on the CX-4 concept.

A House armed services subcommittee has recommended that funds be made available to the Air Force for Specific Operational Requirement (SOR) for the CX-4. The recommendation was made in a report of a special subcommittee on national military airlift and recommended that $20 million requested by the Air Force for a Program Change Proposal (PCP) be released by Dept. of Defense at the earliest practicable date.

With money available for further study and implementation of an SOR, the way would be paved for possible Request For Proposals (RFP) which is expected early next year, according to industry spokesmen.

Douglas has sized the CX-4 for a 4,000 naut.-mi. mission with a 135,000-lb. payload. Used in conjunction with the Lockheed C-141, a combination fleet could deliver a fully-equipped Army division to areas within this design range within five days.

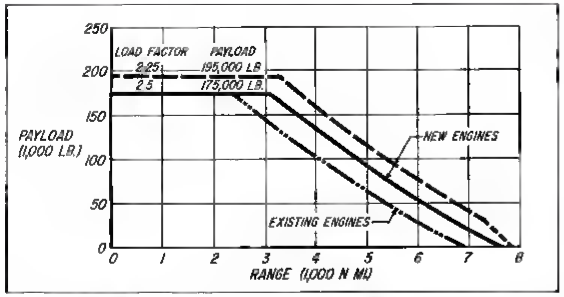
Other areas of potential deployment over longer range legs up to 5,500 naut. mi.—such as southeast Asia—also could be reached, although at reduced payload capability. With a global airlift capability, U. S. troops could be withdrawn from many foreign bases and relocated in the U. S.

Douglas feels that if a development program were begun in the middle of Calendar Year 1965, the first aircraft would be built and flown in 33 months. Aircraft could be in squadron use near the end of Calendar Year 1969, according to this timetable.

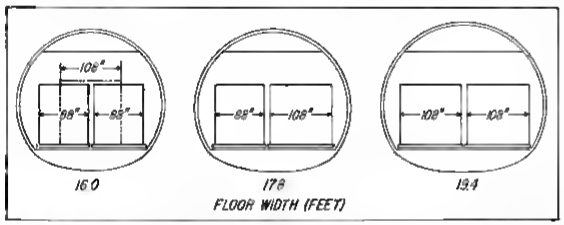
The Douglas presentation outlined the company's effort in analyzing the CX-4 over the past three years. This effort included fabrication of a detailed full-size wooden fuselage mockup, which has been valuable in studying loading and unloading techniques. The mockup version, built with a 16.0-ft. x 100-ft. floor, is known as the D-902 version of the CX-4.

Current version of the CX-4 employs a 17.8-ft. by 110-ft. floor and is known as D-906. Design details of the D-906 include:

- **Swing nose.** The nose section, including the cockpit, swings completely away from the fuselage. Control cables are carried across the hinge and pressurization and air conditioning ducts employ press-fit connections with shut-off valves located at the break points. The nose would be swung to the right side of the aircraft and could be opened in winds up to 40 to 60 kt. Advantages of the swing nose are the large loading entrance and drive-through loading and unloading. An aft loading door adds an approximate weight penalty of only 1.5% of gross weight. Design of the empennage section is simplified from an aerodynamic drag and weight standpoint which would be considerations with a swing tail or larger aft ramp.
- **Floor width** of 17.8 ft. Although the mockup was built with a floor width of 16.0 ft., recent cost effectiveness studies indicate that a 17.8-ft. floor width is desirable. Exact floor size was determined by a secondary mission of transporting palletized cargo since widths of 15 to 19 ft. are acceptable in transporting lighter Army airborne and infantry divi-



RANGE AND PAYLOAD performance of proposed CX-4 transport are shown in chart (above) with existing and new engine designs. Cross-sections of three fuselage widths (below) have been considered



sions. For heavier mechanized and armored divisions, widths between 13 and 24 ft. prove feasible. The 17.8-ft. floor width was chosen from three ranges—16.0, 17.8 and 19.4 ft.—dictated by efficient loading of standard 463L pallets (88 by 108 in.). Douglas feels a floor length of 110 ft. is optimum for a 17.8-ft. width. This provides an internal volume of 26,786 cu. ft. including the aft ramp area and 24,969 cu. ft. considering only the basic floor area.

• **Design range** of 4,000 naut. mi. This would provide direct airlift capability from U. S. to Europe. However, to achieve global airlift capability, including Southeast Asia deployment ranges from 5,000 to 5,500 naut. mi. are necessary. Douglas' payload versus range studies indicate that a CX-4 designed as a 4,000-naut.-mi. aircraft still could deliver a 75,000-lb. payload (2.5 load factor and six 30,000-lb.-thrust engines) on a 5,500-naut.-mi. leg. The same aircraft could deliver a 135,000-lb. payload 4,000 naut. mi. and a 175,000-lb. payload approximately 3,100 naut. mi.

• **Capability to operate** from support area airfields to provide an effective airlift capability on a global basis. The CX-4 will have to operate into and out of unimproved fields of 3,500 ft. or more. Due to difficulties of defining a standard surface condition for such airfields defined by the Army Corps of Engineers as support area airfields, Douglas has not defined a landing gear in detail pending further amplification of requirements. But it is confident that the design of a gear to meet the anticipated requirements is feasible. In preliminary work on landing gear configurations Douglas has used surface conditions ranging from CBR (California bearing ratio) of 12 to 20.

One representative design for a CBR 16 or better surface condition is a gear employing 16 17-by-20-in. main tires with two sets of dual tires for each of four struts. Tires would be inflated to 125 to 135 psi. for takeoff and deflated to 80 to 85 psi. for landing. This would require an in-flight air-bleed system, which Douglas feels is feasible.

Destination Performance

Destination performance has been sized for landing a 160,000-lb. payload in 3,070 ft. plus sufficient fuel for a 1,000-naut.-mi. return trip. Takeoff distance after off-loading the 160,000-lb. payload is calculated at 2,750 ft., including additional fuel for a 4,000-mi. flight. All fuel tanks would be located in the wing.

The Douglas CX-4 is designed to cruise in the Mach 0.80 speed range at approximately 30,000 ft. Takeoff weights calculated by Douglas for its 16.0, 17.8- and 19.4-ft. floor width versions are 487,000, 618,000 and 720,000 lb. respectively. Calculated takeoff distance with a design payload weight of 135,000 lb. is 7,300 ft. on a 90F day.

The 17.8-ft. floor width version has a wing span equal to its length of approximately 190 ft.

The forward ramp has an 11-deg. rise and the aft ramp angle is 15 deg. due to a 1-deg. rise in the floor from nose to tail. The aft end, with a 9- x 10-ft. airdrop opening, actually has a vertical clearance of over 12 ft. when the ramp is lowered from the horizontal position to the ground for loading.

Size and number of powerplants used on the CX-4 will be determined by requirements spelled out in the as yet unwritten specifications. Douglas' current proposal however features a new 30,000-lb. thrust category engine, although the company has studied use of existing engines such as the Pratt & Whitney TF33, which would develop 23,000 lb. of thrust. Use of lower thrust engines reduces the design payload capability from 135,000 lb. to approximately 105,000 lb. over 4,000 naut. mi. Douglas is currently considering using six engines on all three possible floor width versions.

System Cost

As viewed by Douglas, development of the CX-4 for the troop and equipment deployment mission is not only economically feasible but would minimize total airlift capability system cost. A basic problem in deploying an Army division is the relatively low density of the cargo. With existing aircraft, having floor widths from 10 to 12 ft., the average floor loading for Army deployment missions is 40 to 50 psf. This compares with 110 to 150 psf. for resupply missions.

Thus the CX-4 would be a primary carrier of low density cargo, which it has been sized for, leaving the high-density payloads for the C-141.

A fleet of CX-4 and C-141 aircraft consisting of approximately 127 of each would be an optimum fleet according to Douglas studies, although operational requirements are so ill-defined at the present time that this mix admittedly is based only on best estimates. Their studies also show that approximately one-third of a reorganized Army division in terms of weight cannot be carried in a C-141. Composition of the division for study purposes was composed of 8 infantry, 1 mechanized and 1 armored battalion.

A proposed troop/cargo version of the CX-4 would be able to carry 126 troops in an upper deck extending rearward from the midpoint of the aircraft. Troops would be seated backward, seven abreast. Palletized cargo could be carried in the main cargo compartment, which has a 9-ft. ceiling to floor clearance, below the troop deck. Troop seating can also be arranged by converting the two full-length walkways on either side of the fuselage into bench seats.

THE BOY IN THE DARK TRUNKS

LEACH HERITAGE OF THE AIR—28

"Air battles regularly took place over the static lines, where tens of thousands of soldiers of both sides used the sky as a kind of theatre. Or perhaps more like an aerial boxing ring — the troops saying, 'That's my boy in the dark trunks on the left.'"

The man who wrote those words is Raymond Collishaw. Forty-six years ago he was Flight Lieutenant Collishaw, Commander of the Black Flight of Number 10 Naval Squadron—destroyer of 60 German planes, and a great British ace of World War I.

The Black Flight was made up of men, who, like their leader, were Canadians in their early twenties. The planes they flew were Sopwith Triplanes dubbed "Black Roger," "Black Death," "Black Sheep," and "Black Prince." Collishaw piloted the "Black Maria."

Powered by a 130 h.p. Clerget rotary engine, the Sopwith Triplane was one of the most maneuverable fighters of the time. It was 18 feet 10 inches long, had a span of 26½ feet on all three wings, and was armed with one fixed synchronized Vickers machine gun in front of the cockpit.

The most remarkable feature of the Sopwith Triplane was its climbing ability. It could reach 15,000 feet in 19 minutes! Collishaw and his Black Flight often climbed to 19,000 feet twice a day. They'd stay up there—without oxygen—searching for German planes to shoot down.

And shoot them down they did. By June 24, 1917, the five young Canadians had shot down a total of 66 German planes. In June and July of that year, Collishaw had 29 kills to his credit.

Unlike Richthofen's "Flying Circus," whose tactics were largely defensive, the Black Flight sought out the fastest German planes it could find. Plainly and simply, Collishaw's Canadians were looking for a fight.

And they fought well. So well, they didn't have one casualty until June 26, 1917. On that day, they met up with Richthofen's whole squadron. Flight Sub-Lieutenant J. E. Nash in "Black Sheep" was separated from the group and attacked by two Albatroses, one carrying Richthofen himself, the other Lieutenant Karl Allmenroeder, number two man in the German squadron. Allmenroeder out-maneuvered Nash, and after a long burst from his Spandau guns, sent the Canadian crashing to the ground. Nash lived, though, to spend the rest of the war in a German prison camp.

The Black Flight was bent on revenge. And the next day, they went hunting. From their flying perch, 19,000 feet up, they spotted seven Albatros fighters below them. They were part of Richthofen's Jagdstaffel 11, dreaded German wolf pack. Flying the lead plane was Lieutenant Allmenroeder.

By a pre-arranged plan, Collishaw gave the Black Flight the signal to attack. He flew in the middle with two Sopwiths on each flank.

Because of previous bouts with Jagdstaffel 11, the Canadians knew the danger of flying below it. So, they dove straight at the German formation, began firing at long range, and kept up the barrage until, at the last possible second, they pulled up just above their targets. Their tremendous speed carried them above the Albatroses again, ready for another attack.

On that first dive, Collishaw headed for the lead plane. After he fired for a few seconds, Allmenroeder flipped on his side, began to spin, and whirled to his death. Nash was pleased.

Collishaw kept knocking off Germans until September 1918, when he was sent to England to help organize the Royal Canadian Air Force. He stayed until the end of the war.

At this time, the royal soldiers of the Tsar were in a last ditch struggle against the Bolsheviks. They needed air support. The British sent them a squadron commanded by Lieutenant-Colonel Collishaw. When the Bolshevik regime succeeded, Collishaw took off for Persia where more Reds were causing trouble.

Finally, after six years of continuous fighting, Collishaw put his gloves away and began rising through the ranks of Canada's peacetime air force.

He put on the gloves one more time. As an Air Vice Marshal, he commanded the R.A.F. in the Middle East during World War II. Now living in Vancouver, British Columbia, the boy in the dark trunks has retired undefeated.

News Digest

Pan American World Airways and Trans World Airlines formally terminated their merger agreement last week. The agreement, pending since Dec. 20, 1962, had lost much of its impetus by last spring (AW Mar. 4, p. 33).

International Business Machines Corp. will assemble, integrate and check out instrumentation and guidance equipment for the Saturn 1B and Saturn 5 rockets under a $75 million, five-year NASA contract.

Tiros 6 weather satellite, launched Sept. 18, 1962, stopped sending usable cloud cover pictures last week. NASA said that after 13 months of nearly perfect operation, a malfunction in the vidicon camera focus current regulator caused it to send fuzzy pictures. Attempts were being made to diagnose and correct the trouble.

Dr. A. A. Griffith, retired chief scientist of Rolls-Royce and developer of the Flying Bedstead vertical takeoff and landing research vehicle, died Oct. 11 at 70.

AC Spark Plug, Raytheon Co. and the Kollsman Instrument Corp. will develop and build navigation and guidance systems for the Apollo Lunar Excursion Module. The three firms under direction of the Massachusetts Institute of Technology are developing the Apollo command module guidance and navigation systems (AW May 14, p. 27, June 24, p. 38).

Chief Air Marshal Pavel Fedorovich Zhigarev, who headed the Red Air Force from 1949 to 1957, died recently in the Soviet Union at 63. Zhigarev also was chief of Aeroflot, the Soviet-owned airline, during the period from 1957 to 1959.

Two-man cockpit arrangement of the Douglas DC-9 has been accepted by Federal Aviation Agency pending flight demonstration.

Massachusetts Institute of Technology's Research Laboratory of Electronics has observed concentrations of minute particles thought to be noctilucent clouds and meteorite fragments at 50 and 70 mi., respectively, with optical radar using an Radio Corp. of America ruby laser. Initial findings suggest that very small meteors continuously strike the earth's atmosphere and fragment into still smaller particles which settle to earth rather than burn up, as previously believed.

U.S. Carriers Support SST Development

Four airlines indicate intentions to buy 29 supersonic transports; Boyd warns Senate unit of pitfalls.

By Robert H. Cook

Washington—Four major airlines moved to support the nation's supersonic transport program last week by placing tentative orders for 29 aircraft with the Federal Aviation Agency, thus offering the first competition for the British-French Concorde supersonic transport.

Trans World Airlines, Pan American World Airways, American Airlines and Flying Tiger Line are seeking early positions on a future U.S. supersonic transport production line, underlining the airline industry's deep concern over the competitive problems that could arise from the development race between the U.S. program and the British-French combine building the Concorde.

Announcement of the orders coincided with the opening of hearings by the Senate aviation subcommittee on the supersonic transport program.

Chronology of the orders also highlighted the fierce competitive battle between TWA and Pan American over which will be first to operate a supersonic, and the concern of American over the prospect of a supersonic competitor on the long-haul transcontinental routes. Orders were placed in this sequence:

▪ **TWA announced on Oct. 14** that it has agreed to purchase six U.S. supersonic transports, and gave FAA an initial down payment of $600,000. The order called for the "first and thereafter every second plane" to a total of six. TWA said it would accept a speed of Mach 2.2 for the aircraft although it hoped Mach 2.4 might be attained.

▪ **Pan American,** the same day, advised FAA that it would purchase fifteen of the aircraft, enclosed a $1.5 million down payment, but bitterly protested that it had not been accorded the first delivery positions. When the company ordered six Concordes last June, Pan American contends it made the first offer to purchase a U.S. supersonic. Just prior to the TWA order, Pan American said, it repeated this offer to FAA but failed to receive any answer until the agency advised it had already given first positions to TWA.

The airline said it was willing to accept delivery of every second aircraft beginning with the first or second delivered until its order for the transport was filled.

▪ **American** announced two days later, on Oct. 16, it had agreed to give FAA an initial $1.5 million down payment toward the purchase of the first six U.S. supersonic transports, in an Oct. 10 telegram. At the same time the airline said it had signed an agreement to purchase four Concordes. The airline noted that should the U.S. abandon its own supersonic program, the Concorde order would be "good insurance." Continental Air Lines, a competitor of American between Chicago and the West Coast, has ordered three Concordes from the British-French combine.

▪ **Flying Tiger** notified FAA on Oct. 16 that it is ready to place a downpayment on two supersonic transports, but was confused over how much to offer since it had no formal notice from FAA that orders on the supersonic were being accepted. The only knowledge which Flying Tiger claimed it had of the situation was published reports of the TWA and Pan American down payments. The cargo airline said it would request a convertible cargo-passenger version of the supersonic.

More supersonic orders may be announced in the near future since FAA has contacted five of the eleven trunk and international airlines but there remains some uncertainty over whether or not the agency has authority to either accept down payments or attempt to guarantee positions on production lines.

As of late last week, FAA had not replied to the purchase offers explaining that it must first ascertain whether it has the legal authority to accept the money. If it has the down payments will be placed in a special account with the U.S. Treasury Department, the agency said.

Testimony of CAB Chairman Alan S. Boyd reflected an airline fear that it faces the risk of buying an aircraft that may be technically feasible, but operationally uneconomical. FAA has been pressing for a Mach 2.5 design speed and National Aeronautics and Space Administration favors a Mach 3 speed. Former NASA aircraft designer John Stack recently told the New York Academy of Sciences that a supersonic transport with an efficiency comparable to that of today's subsonic turbojets must be designed for Mach 3 "or higher." Stack is now Republic Aviation vice president.

The object of producing a supersonic transport is not to overcome technical difficulties," Boyd emphasized, "but to produce a product which will serve the public most economically and conveniently." He said that the closer economics are studied, the more technical tradeoffs must be made.

Although he assured the Senate aviation committee of the Board's full support of the FAA program, Boyd emphasized that "we'll take the leadership on economics," indicating his feeling that CAB is the best qualified agency to analyze economics of the program.

Boyd said he considers the supersonic aircraft a "logical evolution" in aircraft that may someday reach a hypersonic design. He said the U.S. and the British-French are "wearing rose-colored glasses" in predicting delivery dates on the new aircraft. More important than early delivery dates, he noted, is the need to assure profitable operation.

Airline concern over delivery positions could cause a serious problem, he said, in that companies unable to secure favorable positions could literally "go broke" awaiting deliveries and be forced to compete with subsonic transports against supersonics.

No one carrier can be permitted to monopolize the delivery line and an equitable method of distribution is needed, he said.

Subsidy Payments

FAA does not intend that subsidy payments will be required by supersonic operations, but American carriers that failed to purchase the Concorde might suffer such competitive losses that they would require subsidies for survival, he explained.

Boyd also termed estimates that the U.S. supersonic will be profitable over stage lengths of 1,700 mi. as "debatable," suggesting that profits will depend on longer routes. As an example, he cited the 1,100-mi. distance between Miami and Washington, pointing out that profitable operation would require a Miami-Washington-London routing. In many cases it will not be possible to operate turn-around service on such short segments. He said extensive use of the supersonic transport will require a realignment of many existing major route structures.

This point conflicts with statements of Gordon M. Bain, chief of FAA's supersonic transport program, who said a profit can be made on 1,000-mi. stage lengths (AW Oct. 14, p. 38).

Supersonic transport fares must not carry a surcharge, for "once the thrill is over" the public may not be willing to pay the difference, Boyd said, adding that improved service has always done more than new equipment to attract passengers.

Traffic growth should be able to support the addition of the new aircraft, Boyd said since the CAB expects it will reach 77 billion revenue passenger miles by 1970, or nearly twice the total of last year.

Boyd said CAB anticipates some foreign countries will impose restrictions on U.S. supersonic operations as a competitive measure, but he is confident this could be solved. He said authorization may be needed to lend money for foreign countries to buy the U.S. built transport. He added that groups of two and three airlines may band together for supersonic operations in Europe and the Middle East and this arrangement could lessen competition for U.S. flag carriers.

Operating Objectives

Proposed operating objectives of the U.S. aircraft also came in for strong criticism from Boyd, who particularly objected to the aircraft's lack of range and capacity as compared to the present subsonic transports.

The FAA proposal calls for a range of 4,000 mi. compared with the subsonic turbojets, which fly daily nonstop 4,300 mi. between New York and Rome. It would be a "step backward" if these nonstop services could not be maintained with the supersonic aircraft, he said.

"It would be unfortunate . . . to create a system of supersonic transports which caused a condition of hurry up-and-wait because of need for frequent and lengthy fuel stops," Boyd said.

Design payload of the supersonic transport is also about 25% less than that of the present subsonic airliners and should be increased to at least equal that of the present jets. In the past, Boyd contended, the airline industry has always succeeded in achieving increased speed with an increased payload.

These problems have a direct effect on the industry's efforts to lower its unit costs, Boyd pointed out, and "carriers will be cautious in trebling their investment in a single aircraft merely to reduce the travel time from mid-town Manhattan to mid-town Miami less than one third, particularly when it appears unit costs will not be reduced below those of jets."

Russia in SST Race

Washington—Russia is concentrating on an aluminum Mach 2.2 aircraft as its entry into world wide competition to produce the first commercial supersonic airliner, according to Gordon M. Bain, deputy administrator of the Federal Aviation Agency in charge of the supersonic transport program (AW July 15, p. 21).

Bain told members of a Senate aviation subcommittee investigating FAA's supersonic transport program that the Soviet is too limited and was not considered as great a challenge to the U.S. program as is the British/French development of the Mach 2.2 Concorde. Part of the reason, he explained, is because of the Soviets' past failure to sell their turbojet airliners.

Earlier he told the subcommittee that FAA favors the use of titanium for a U.S. supersonic transport. Cost and processing problems which have been high in the past are being lowered and more is known about the use of titanium now than the aircraft industry knew about the use of aluminum when the present subsonic airliners were being designed, he said.

Short Brothers Turbo-Skyvon Makes First Flight

Short Brothers and Harland Turbo-Skyvan which recently made its first flight (AW Oct. 7, p. 37) shows new engine nacelles designed for Turbomeca Astazou 2 turboprop engines, which replaced the Continental piston engines used in the earlier Skyvan. Prototype will complete flight test and certification program with the 550-hp. Astazou 2s, but production aircraft will be powered with Astazou 10 engines of 637 shp. each. With the latter engine, the Turbo-Skyvan will have a cruise speed of 186 kt. and will carry a maximum payload of 4,000 lb. Approach speed is 81.5 kt. and landing distance is 1,800 ft.

N.Y. Helicopter Crash Investigation Speeded

New York—Investigation of the crash of a New York Airways Boeing Vertol V-107-2 helicopter at Idlewild Airport was speeded late last week in hopes of getting the line back into service as rapidly as possible.

The airline voluntarily suspended passenger service after the Oct. 14 crash which killed six. However, its remaining three Vertol helicopters were not grounded and were flying. A spokesman for the airline said they would be returned to service as soon as something definite was known about the cause of the mishap.

Wreckage of the helicopter was moved Thursday to La Guardia airport, where the airline has its headquarters.

and maintenance base, and investigation teams worked a night shift, headed by Civil Aeronautics Board Investigator Lee Martin, tearing down subassemblies. The two General Electric CT-58 turboshaft engines were sent to the manufacturer's factory at Lynn, Mass. for teardown.

The accident occurred at 12:33 p.m. Oct. 14 as the helicopter was departing Idlewild for New York's Wall Street heliport and Newark, N.J., airport.

The helicopter was at an estimated 100-ft. altitude and moving forward at about 60 kt. when it lost power and fell on its side adjacent to taxiway Romeo. Witnesses reported hearing a report as the ship fell.

A 4-ft. section of the front rotor was found approximately 3,500 ft. from the crash site on top of American Airlines hangar 10 and another rotor section landed on a parked car nearby.

Federal Aviation Agency personnel said it was possible for the force of the impact to have thrown the rotor section on top of the hangar. The rotor was turning at 248-264 rpm. when the accident occurred.

In the meantime, the airline was losing an average of slightly less than 1,000 passengers per day who normally take the shuttle service.

The accident came at a time when New York Airways was scheduled to begin service to the Port of New York Authority heliport at the site of the 1964 New York World's Fair.

The airline will take delivery on what would have been its fifth V-107-2 later this month. The machine is undergoing final checks at Boeing's Vertol Div. factory in Morton, Pa.

The carrier also is pressing for permission to use the rooftop heliport on Manhattan's Pan Am Building, but public opposition already has been expressed before the present accident (AW May 27, p. 36). The City Planning Commission is preparing to hold public hearings on the application, but no date has been set.

Local Service Airlines Protest Adverse Report, Cut in Subsidies

Washington—Local service airlines last week fired back at the critical analysis of the industry prepared last summer by the Civil Aeronautics Board for the White House (AW Aug. 19, p. 38). They called the study a "budgetary chop in the dark."

In a blunt reply to the CAB report, which called for a reduction of local service airline subsidies by at least one-third over the next five years, the industry charged that the report fails to take into account the service provided by the industry and the public benefits that result. The industry statement came shortly after the House cut $8.7 million in CAB funds for airline subsidy and a statement earlier last week by Board Chairman Alan S. Boyd, that $65.6 million may be adequate subsidy for Fiscal 1964.

The House cut reduces the local service industry subsidy for Fiscal 1964 from a requested $83.8 million to $75 million. Last week, Boyd appeared before a Senate Appropriations subcommittee urging restoration of the cut.

However, during his testimony, he suggested there is some possibility that a reduction in the rate of return on equity from 21.35% to 16%, "blanket allowances" under the class mail rate and a projected increase in local service load factors could result in a $65.6 million subsidy need.

In their rebuttal, which was prepared by System Analysis and Research Corp. for the Assn. of Local Transport Airlines, the carriers said they had read the CAB report with "disappointment and apprehension." They deplored the report's failure to offer an affirmative program for strengthening the industry, and expressed a fear that the report's "erroneous forecasts of subsidy decline may form the basis for governmental planning and action."

On this point the local service carriers charged that the forecasts contain certain implausible assumptions. These include:

- **Assumption that local service** revenues will exceed added costs by 100% during the next five years. This assumption, the carriers held, is inconsistent with cost behaviors adopted elsewhere by the Board and is based on the theory that airline capacity can be distributed to coincide neatly with traffic.
- **Assumption that large subsidy** reductions can be effected by limiting the number of schedules in high density traffic markets. The carriers said that, to the contrary, subsidy is generally reduced by placing high frequency operations in such markets.
- **The report "seriously underestimates"** the cost of adding a second round trip to every local service point, as it recommends.
- **Assumption that inflation** will be overcome by increasing productivity.

The carriers charged that the report failed to appreciate the relationship of more efficient equipment to a reduction in subsidy. They claimed that the report, while professing an interest in the development of new aircraft, offers no encouragement of a positive nature in this respect.

The industry stated that the Douglas DC-3 is not an adequate aircraft, and that the airlines would be more heavily subsidized if they were still operating only DC-3s today. It noted the need for a re-equipment program, and then added:

But a government policy of passive acceptance is not enough to bring the right airplane into being. For certain high density segments the operation of new low-cost short haul, jet-powered aircraft also appears to hold great promise. Yet the Board has thus far refused to agree to even an experiment with the newest equipment types."

The carriers said that, despite the weaknesses in the report's forecasting, the real deficiency lies in a failure of the report to propose a program that would control subsidy by the strengthening of routes.

They added that any significant subsidy reduction requires access to more profitable markets.

They charged that the report leaves the impression that the strengthening of the route structure is "so new, so complex and unexplained" that it cannot be analyzed. The carriers then noted that the Board has had more time to consider, and has been given more information about, the problems of route structure and operating restrictions on routes than any other matter concerning the local service industry.

The carriers cited the award of nonstop authority to Bonanza Airlines in 1962 on the Las Vegas-Los Angeles route. They said that, even before Bonanza inaugurated the service, the Board reduced the airline's subsidy to $114,000.

They added that, in the 18 months of the Bonanza operation on the route, subsidy need has declined, operating profit has climbed and operating expenses and breakeven need has declined. Bonanza's access to this market, they explained, was accomplished merely by removing the restriction that the carrier must serve one intermediate point on the route.

Here is how the local service industry summarizes the subsidy problem:

- **Portion of local service** subsidy is attributable to the transfer of unprofitable points from trunklines to local carriers. Trunkline profits have grown as a result of their being relieved of an obligation to serve these points. The Board has failed to transfer some of the profitable markets on medium haul routes to the local service carriers.
- **Local service airlines** are not obtaining enough revenue to meet need. Locals are contributing to trunkline profits by generating about $70 million in traffic each year for the trunklines.
- **Trunklines** dominate long-haul markets and almost all short-haul high density markets.

ATCA, Halaby Clash on Control Problems

Dallas—Air Traffic Control Assn. differed sharply with Federal Aviation Agency Administrator Najeeb Halaby here last week over controller staffing needs and progress being made in modernizing the nation's traffic control system with new equipment.

"The days of billowing expansion are over," and FAA has arrived at the point where adding more men will not improve the quality or capacity of the traffic control system, Halaby stated in a speech at the eighth annual Air Traffic Control Assn. meeting. The association's executive director, Edward H. Cockerham, disagreed with Halaby and stated that approximately 15% more personnel are required to handle the constant expansion in service being offered airspace users. There are now approximately 11,000 civilian controllers.

Cockerham stated that new equipment is not solving the manning problem, but increasing the need for additional people. With introduction of radar coverage, for example, there is additional work involved, including radar "hand offs" of aircraft from one sector to another.

Discipline Criticized

Dallas—FAA's Air Traffic Service was strongly criticized by Air Traffic Control Assn. members for disciplinary methods affecting controllers. Primary complaint was that hearings on such violations are conducted by personnel with little or no recent controller experience and thus little appreciation of the present working environment.

The requirements imposed on controllers at times to maintain high productivity while listening on as many as six different frequencies simultaneously, correcting flight strips and attempting to receive instructions from a supervisor impose stresses that they feel are not considered when complaints are lodged. Judgments imposed following careful consideration of evidence, with many hours given to study of what should have been the correct decision on the part of a controller who had only seconds to act are many times unfair, controllers say.

ATCA noted that an FAA study revealed that the airlines lost more than $58 million through bad weather delays, diversions and cancellations in 1959 and a loss of more than $67 million is anticipated this year.

In the year ended this February, over 10 million flights were controlled by the centers, a 2% increase over last year. At the towers, traffic was up 6%, for a total of 28.5 million controlled landings and takeoffs.

Halaby appeared adamant on the subject of maintaining the line in personnel. He indicated that Congress has demanded that the agency, now the government's eighth largest, employing about 46,500 people, level off, and that ways must be found to increase the benefits provided the airspace users without increasing personnel.

ATCA spokesmen pointed out that the problems of staffing are decided by management personnel who too often consider statistics as the gauge of staffing needs.

Halaby also did not appear optimistic about reaching a solution soon to the retirement program sought by the association, which would permit controllers to retire at age 50 after 20 years of service or the possibility of inaugurating a maximum entry age because of the difficulties of obtaining passage of legislation required to amend the Federal Employes Retirement Act or entry requirements.

Controllers strongly feel that current retirement provisions are inadequate in not taking into account the stressful nature of a traffic controller's job. By age 50, they say, the average controller is unable to handle his job efficiently.

Halaby indicated that he favored early retirement, but also pointed out that there is little actual statistical or medical evidence available to support a case for such an action.

FAA Studies

FAA's Civil Aeromedical Research Institute is making studies to determine the psychological and physiological stresses on air controllers, but these are primarily geared to determining the need for expanding health examinations to uncover pressures and means of alleviating them.

Halaby also took into account the association's plea for a minimum entry age for controllers, which ATCA feels should be 26. He cited figures showing high drop-out rates among trainees in relation to age. Studies show that 60% of the recruits over 35 years old don't make the grade, while the failure rate below 35 is 34%, Halaby said. A great deal of money could be saved if FAA could limit controller recruits to those under 35 years old, he said.

The FAA administrator noted studies made by the Civil Aeromedical Research Institute to determine the effects of age, background, environment, personality, attitudes and other factors on successful controllers, and said that a battery of tests has been evolved which will be used in future examination of new recruits. Examinations using these tests will be announced in FAA's regional offices sometime early next year.

Halaby said improvements in management, facility realignments, improved equipment and procedures, have made possible marked gains in individual controller productivity. The percentage increases in productivity from Fiscal 1959 to Fiscal 1964 has been 22% in centers, 12% at terminals and 14% at stations, he stated. FAA is forecasting an overall increase of 4% in productivity at all facilities in Fiscal 1964 over Fiscal 1963.

The FAA administrator also reported that increase in new equipment is planned, such as improved data processing systems, remote strip printers and controller updating equipment, to ease the controller's load.

'Slow Process'

But ATCA's executive director was pessimistic on re-equipment, stating that the process was too slow and did not keep pace with increased requirements and air traffic loads. He said that fully automated systems easing the traffic control environment are about 10-15 years away from use.

Cockerham was also critical of radar installations at many airports, noting that funds spent on modifying what he termed out-of-date radars in an attempt to modernize them, could be spent far more effectively by purchasing new equipment. He pointed out that too many critical traffic points, including Dallas, Seattle, Houston, San Francisco and Philadelphia, still have ASR-2 equipments which require considerable judgment on the part of the controller in evaluating their information.

Family Fare Probe

Washington—Civil Aeronautics Board last week suspended a United Air Lines family plan tariff on its single-class service (AW Sept. 16, p. 43), and at the same time, ordered an expedited investigation of this and other family plan discounts.

In a 3-2 decision, the Board said it took the action "to prevent what may well be irreparable damage to the majority of the industry." The minority opinion presented by Vice Chairman Robert Murphy and Member G. Joseph Minetti held that carriers should be allowed to test their tariffs "in the market place."

The Board order indicated concern over family discounts on one-class and coach service. Although the family plan on first-class services is not directly affected by the order, it too will come under the scope of the investigation.

Pakistan Route Could Link U.S., Russia

By L. L. Doty

Rome—Pakistan International Airlines, only International Air Transport Assn. carrier with authority to serve both the Soviet Union and Red China, is developing a route pattern that could link the U.S. with Russia on a Karachi-Moscow-New York route.

Air Commodore M. Nur Khan, managing director of the airline, said here during IATA's 19th annual general meeting (AW Oct. 7, p. 38) that the newly signed bilateral air transport agreement between Pakistan and Russia (AW Oct. 7, p. 43) calls for the establishment of four points beyond Moscow in the operation of the Moscow-Karachi service. The carrier may choose any four points it wishes under the terms of the agreement, has definitely selected London as one and considers New York as the next logical choice.

PIA is now conducting a survey to determine which other two points it will serve on the new route. With its recently acquired route into Red China (AW Sept. 2, p. 31), the airline will be able to offer the only direct through air service from the western hemisphere into Russia and beyond to Shanghai and Canton.

Pakistan will be required to negotiate for landing and traffic rights with the U.S. and Great Britain, as well as with the two other countries it decides it wants to serve, before regular service can be inaugurated. Nur Khan said he foresaw no obstacles in this connection.

Under the reciprocal agreement with Russia, Aeroflot gains four points beyond Karachi on its flights to and from Moscow. These, which were predetermined, are Colombo, Rangoon, Jakarta and New Delhi.

Both Aeroflot and PIA will have beyond traffic rights—the right to carry fifth freedom traffic at Karachi and Moscow respectively.

The Moscow-Karachi service is slated to begin in April. Beyond services will be inaugurated as traffic trends are developed. Nur Khan stated that the Russians were particularly cooperative in offering to provide PIA with traffic information that would assist the carrier in planning its schedules and route pattern. The airline will be permitted to base its own maintenance and operations personnel in Moscow.

The agreement, Nur Khan said, is similar in form and content to those bilateral air transport agreements that have been signed with western countries. The Pakistan-U.S. agreement includes the Bermuda principles.

This week, the airline is sending a team to Japan to begin negotiations for landing and traffic rights at Tokyo on the proposed Karachi/Dacca-Shanghai-Canton-Tokyo route. Thus far Japan has shown no signs that it is ready to agree to this but here again, Nur Khan is optimistic over his chances of gaining entry into Tokyo.

Japan has been anxious for several years to expand its trade with Red China, and would like to provide air service into China as a supplement to that trade, but has been restrained by a fear of damaging relations with the U.S. Red China, meanwhile, has also expressed a desire to enter into the international air transport arena as a first step toward expanding its trade with the western world and Africa (AW Oct. 7, p. 47).

Service into Red China is to start in April, according to Nur Khan. He said that the agreement with the Chinese contains no unusual provisions or restrictions, and that all normal traffic rights have been granted to PIA by the Chinese without any conditions pertaining to the nationality of the passengers carried into China or transiting the country.

Nur Khan said it was his opinion that the Chinese would not begin air service on the route into Pakistan at the same time that PIA inaugurates service because of lack of equipment. He said he believed that the Chinese were interested in the Sud Caravelle (AW Oct. 14, p. 45), but would also like to consider the de Havilland Trident and the Boeing 727 as replacements for its Vickers Viscount fleet.

Nur Khan admitted that PIA had an equipment shortage problem of its own, and added that he had been unsuccessful in leasing a Boeing 720 transport to permit continuation of the transatlantic services during the 5,000 hr. block overhauls of the three Boeing 720B transports that constitute its jet fleet. The airline suspended service Oct. 4 for three months pending completion of its current overhaul schedule (AW Oct. 4, p. 49).

Nur Khan told AVIATION WEEK & SPACE TECHNOLOGY that the airline would order additional Boeing 720Bs, but that the number which will be involved in the re-equipment program will be determined by the traffic generated on the new routes.

Nur Khan said he anticipated a profitable operation on the new routes. He specifically referred to the growing number of trade fairs in the Far East, and forecast a gradual breakdown of trade barriers throughout the region. Next month, the airline will send an economics team to China to explore further the traffic potential there. In this connection, he said he had noted that the trains operating between Hong Kong and Canton were carrying a growing number of Europeans.

Nur Khan also said he was satisfied with operational facilities that will be available to PIA in China. Navigational facilities are "up to standard," he said. He does not expect to perform any maintenance and overhaul work within China, but the agreement permits the location of Pakistani personnel at the Shanghai and Canton airports for minor servicing of PIA aircraft.

Nur Khan was accompanied by J. S. Mirza, the airline's commercial director and regular delegate to the IATA annual general meetings.

British Eagle Denied Service Boost

London—British Eagle International, the newest British independent airline, has lost the first round in its fight to compete directly with state-owned British European Airways on its internal routes (AW Oct. 7, p. 52).

Air Transport Licensing Board last week rejected a British Eagle application to increase its services between London and Edinburgh, Glasgow, Belfast and Dublin. The board also turned down applications for new services to Liverpool and Manchester.

At the same time, British Eagle, headed by Harold Bamberg, former chairman of Cunard Eagle, asked the board to restrict BEA capacity on London-Edinburgh and Glasgow services, but this too was denied. The airline was allowed to vary its fares on the routes to bring them into line with BEA tariffs and also to introduce a de luxe class on these routes.

Bamberg said British Eagle would appeal the ATLB decision to Minister of Aviation Julian Amery, who has the power to overrule the board at his discretion.

BEA, in opposing the British Eagle requests, had cited heavy capital expenditures in developing traffic on the internal routes and contended the money would be wasted if the present operations were restricted.

BELFAST TURBOPROP TRANSPORT, built by Short Brothers and Harland, is scheduled to fly in November or December.

Two Aircraft Scheduled for Use In Belfast Flight Test Program

Belfast—Two aircraft will be used in flight testing the huge Short Brothers and Harland Belfast turboprop strategic transport (AW Sept. 9, p. 80), with the aim of achieving military and civil certification in 16 to 18 months and 850 hr. of flight time.

The plane, first of 10 ordered by Royal Air Force, was rolled out here recently (AW Oct. 14, p. 37) to start Rolls-Royce Tyne engine run-up tests and taxi trials. First flight will be in late November or early December, three years after the order was placed by British Ministry of Aviation.

Three more Belfasts are in the final assembly bay, with wings attached. A test fuselage was completed last January for stress testing in the water tank at the company's Sydenham airfield.

In-flight instrumentation for the test program is divided into five sections comprising a single system. They are:

- **Digital recording system** capable of simultaneous recording of up to 1,800 different quantities.
- **Frequency modulation system** to record all high frequency data.
- **Direct readout trace recording system.**
- **Auto-observation panels** for in-flight monitoring of safety parameters.
- **Airborne takeoff and landing recording camera.**

The Belfast has a clear hold measuring 12 ft. square by 63 ft. in length, with an over-all height of 13 ft. 6 in. and over all length of 85 ft. Cargo volume is more than 11,000 cu. ft. The plane can carry up to 140 passengers on a single deck. Its design provides for a two deck installation if necessary.

The Royal Air Force aircraft is designated Short SC.5/10. Maximum payload is 80,000 lb., and gross weight is 225,000 lb. Short Brothers also has designed an improved version for the transatlantic cargo market designated SC.5/13, using Tyne 12s driving 18-ft. propellers. Maximum payload is 75,000 lb., and gross weight is 250,000 lb.

The third version is the Jet Belfast swing-nose cargo freighter (AW June 10, p. 28). Jet version uses basically the same fuselage as the turboprop Belfast, plus the same wing used on the Lockheed C-141 StarLifter and a redesigned T-tail section. Engines would be Rolls-Royce Conway RCo. 42 or 43 by-pass engines. Maximum payload would be 125,000 lb., gross weight 360,000 lb.

Approach Decision Cited in Slick Accident

Washington—Crew's decision to continue an approach after losing visual reference to the ground has been cited by the Civil Aeronautics Board as the probable cause of the fatal crash of a Slick Airways' 1049H Constellation last Feb. 3 at San Francisco International Airport.

Two crewmen and two passengers were killed when the aircraft struck approach lights while attempting a landing. Three other passengers and one crewman survived the crash.

As a contributing factor to the accident, CAB listed inadequate monitoring of the instrument approach by the airport's precision approach radar controller.

Although the Slick aircraft had an inoperative glide slope receiver, it failed to notify air traffic control of the malfunction and elected to make an approach solely on the basis of radar advisories from the precision approach radar controller, CAB said.

On final approach to runway 28R, the flight was advised that it was initially high on the glide slope and to the right of the localizer course. The last PAR advisory placed the flight 100 ft. left of course passing the middle marker and 25 ft. above the glidepath, CAB said.

Radar control was terminated at that point, the Board said, despite the fact that the flight had not reported having the approach lights or runway in sight. Accepted procedure for an instrument landing system approach requires that the controller continue to monitor the aircraft position and advise the pilot whenever radar indicates any situation that might endanger the flight. This was not done and the radar service was terminated without advising the pilot, CAB said.

The aircraft struck the approach lights at a point 109 ft. below the glide slope and 1,100 ft. from the end of the runway. CAB concluded that had the controller been monitoring the flight through the approach he would have observed the aircraft's descent below the glide slope and would have advised the crew.

American Profits Rise

American Airlines net profits for first nine months of 1963 of $12,915,095 were double those for the same period last year, the carrier reported last week.

Included in last year's nine-month figure of $6,027,139 was $1,014,000 from gains in sale of property. This year's figure included $580,000 of such profit.

Nine-month revenues rose to $364,770,749 from last year's $349,979,067. Operating expenses rose from $292,676,696 to $294,864,183, and total expenses from $344,965,739 to $352,435,183.

From 200 miles above the South Atlantic, a camera mounted on the main body of an Atlas records the exact moment when two of its three main engines are detached. Speed—7,000 mph accelerating to 17,000 mph.

You are looking at earth from an Atlas heading into space.

Atlas has been on duty with the United States Air Force since September, 1959 as America's first operational intercontinental ballistic missile.

Today it is guarding the peace at 129 launch sites.

As a space launch vehicle for the National Aeronautics and Space Administration, Atlas has lofted dozens of scientific missions. Included are the space flights of Lt. Col. Glenn, Lt. Comdr. Carpenter, Comdr. Schirra, Major Cooper... all of this country's manned orbital flights.

Atlas is built by the Astronautics division of General Dynamics.

GENERAL DYNAMICS

Divisions:
ASTRONAUTICS • CANADAIR, LTD. • CONVAIR • ELECTRIC BOAT • ELECTRO DYNAMIC • ELECTRONICS • FORT WORTH • GENERAL ATOMIC • LIQUID CARBONIC • MATERIAL SERVICE • POMONA • STROMBERG CARLSON

GD

SHORTLINES

► **Algeria and Ghana** have signed a bilateral air transport agreement calling for a direct air route between Algiers and Accra.

► **American Airlines'** freight revenue ton miles for September rose 2% over the same period last year, and 5% for the first nine months of 1963, compared with the same period last year.

► **Bonanza Air Lines** will increase scheduled mileage 26% during November and December through the inauguration of new flights.

► **Customs declaration** forms will be eliminated by U. S. Customs beginning Jan. 1. Thereafter, passengers entering the U. S. will make baggage declarations orally at all airports of entry.

► **Continental Air Lines** has asked the Civil Aeronautics Board for an unlimited extension of its three-class fare plan. Carrier said that as of Aug. 24 when the plan became one year old, passenger revenue miles had climbed 25% during the 12-month period, compared with the same period in the previous year.

► **Pan American World Airways** will cut fares between Seattle and Alaska in half for weekend travel. The 72-hr. excursion rates will apply between Nov. 1 and Mar. 31.

► **Seventh and final** passenger-loading satellite terminal presently planned for the Los Angeles International Airport has been placed in operation. Building will be shared by Continental Air Lines, Delta Air Lines, Pacific Air Lines and Pacific Southwest Airlines.

► **Trans-California Airlines**, an intrastate carrier, has been granted long-sought approval to serve San Francisco International Airport, and hopes to begin service early in November. Exact date of initial service awaits completion of insurance and bonding arrangements. Carrier presently operates three round trips daily with Lockheed Constellation 749s between northern and southern California, serving Oakland in the north and Los Angeles, Burbank and San Diego in the south.

► **United Air Lines** and San Francisco Public Utilities Commission are installing a 450-ft. moving sidewalk at the San Francisco International Airport (AW June 24, p. 41) to accommodate passengers moving between the airport's main lobby and United's gate positions on the terminal's north concourse.

AIRLINE OBSERVER

► U. S. domestic trunklines have reported an industry net profit of $26.7 million for the first eight months of 1963, compared with a net loss of $10.4 million in the same period last year. Industry net profit for the month of August was $15.8 million on operating revenues of $227.3 million and operating expenses of $196 million.

► **Domestic trunkline traffic during September rose 15% over the volume handled in September, 1962, but declined sharply from the peak reached in August. Load factor for the industry in September was 54.4%, a 6% increase over the load factor of the same month last year. Load factor in August was 60.1%, highest level reached since June, 1961, when 61.1% was recorded as the trunkline monthly average. Available seat miles in September reached 65.6 billion, an all-time high for the industry.**

► Alitalia wants its 26% profit quota in Air Union increased because its traffic and route growth has exceeded projections made when quotas were established in 1959. Last year, for example, the Italian carrier reported a 36% passenger traffic increase. Alitalia regards the Air Union plan as inactive now, but feels two possibilities might revive it: necessity to purchase a supersonic transport fleet that might be feasible only as a joint project, or merger of the two U. S. flag carriers—Pan American and TWA.

► **Soviet Union plans to build a "sleeper" version of its Ilyushin Il-62 jet transport. It will have 60 berths. Conventional configuration of the aircraft, now undergoing flight tests, will carry 168-182 passengers.**

► Boeing 727 fuel pump, fuel control and fuel heater systems are "piggy-backed" installation, necessitating only two fuel supply lines for all three units—one incoming and one outgoing—thus saving about 15-20 lines over conventional separate installations of these equipments.

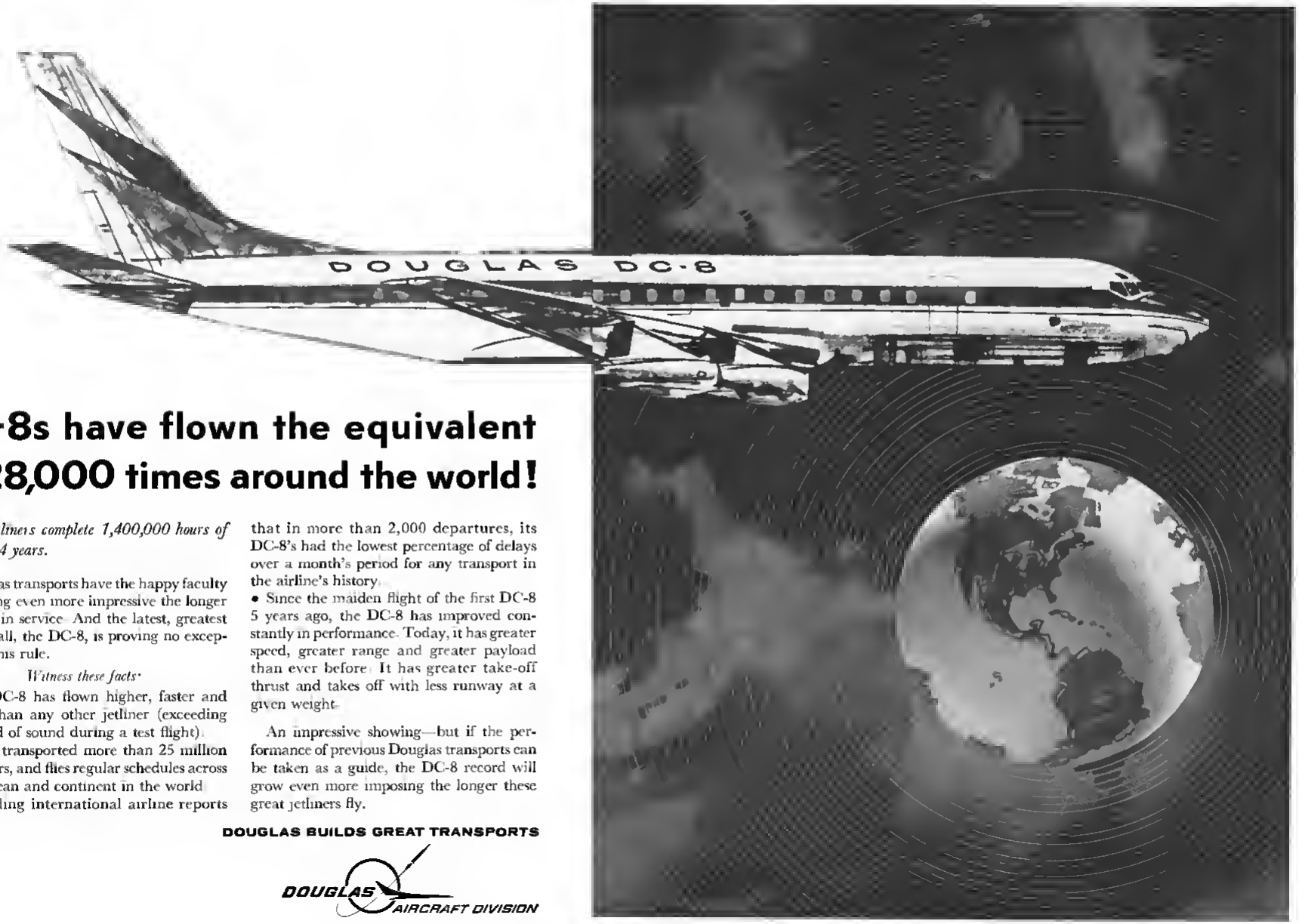
► **Federal Aviation Agency Administrator N. E. Halaby is calling the proposed local service aircraft the "SSSSST" for "small, slow, safe and subsidy-saving transport." Halaby is expected to recommend that the aircraft be developed in a government-funded design competition (AW Sept. 16, p. 49). In outlining possible configuration, he said the aircraft probably would be a turboprop, would seat closer to 16 passengers rather than 38, would cruise at about 225 mph. and would sell for under $500,000.**

► Hawker Siddeley 748 twin-turboprop transport is being offered to operators with 23% increase in fuel tankage to 1,408 imp. gal. Resultant increase in maximum range to 1,760 n. mi. is obtained by extending integral tanks outboard toward wing tips. Use of new single coat tank sealant developed by Products Research Co., Burbank, Calif., and manufactured under license by British Paints, Ltd., allows extension with no increase in structure weight.

► **Local service airlines reported a 12.5% increase in revenue passenger miles in September compared with the same month last year. Available seat miles for the month climbed 9.5% and load factor rose to 44.8%, a 1.2% increase over September of last year.**

► British Overseas Airways Corp. planning section was victimized by its own enthusiasm to fill Boeing 707 seats between London and Prestwick at $6 standby fare for winter night flights. Air Transport Licensing Board approved the fare, advertising and public relations pulled out all stops—and then pushed them back in. Reason: no flights are operated at those times and none are planned.

► Russia's "V/O Technoexport" organization has launched an advertising campaign to sell complete airports to underdeveloped nations. Full-page ad in recent issue of the Soviet magazine Vneshnyaya Torgovlya (Foreign Trade) features a picture of the Russian-built airport at Conakry, Republic of Guinea, and says that "V/O Technoexport" renders technical assistance "in designing and construction of airports and airport installations and delivers all the machinery, equipment and materials necessary for such construction." Another large, Soviet-built airport near Sana, capital of Yemen, was opened last month.



DC-8s have flown the equivalent of 28,000 times around the world!

Giant jetliners complete 1,400,000 hours of flying in 4 years.

Douglas transports have the happy faculty of growing even more impressive the longer they are in service. And the latest, greatest of them all, the DC-8, is proving no exception to this rule.

Witness these facts:

- The DC-8 has flown higher, faster and farther than any other jetliner (exceeding the speed of sound during a test flight).
- It has transported more than 25 million passengers, and flies regular schedules across every ocean and continent in the world.
- A leading international airline reports that in more than 2,000 departures, its DC-8's had the lowest percentage of delays over a month's period for any transport in the airline's history.
- Since the maiden flight of the first DC-8 5 years ago, the DC-8 has improved constantly in performance. Today, it has greater speed, greater range and greater payload than ever before. It has greater take-off thrust and takes off with less runway at a given weight.

An impressive showing—but if the performance of previous Douglas transports can be taken as a guide, the DC-8 record will grow even more imposing the longer these great jetliners fly.

DOUGLAS BUILDS GREAT TRANSPORTS

DOUGLAS AIRCRAFT DIVISION

ALPA Challenges Finding by CAB That Crew Erred in DC-7 Accident

Washington—Air Line Pilots Assn. has disputed the Civil Aeronautics Board finding that faulty crew technique during an abandoned approach was the probable cause of the fatal crash of an Eastern Air Lines DC-7 with a loss of 25 lives last Nov. 30 at New York International Airport (AW Dec. 10, 1962, p. 45, Oct. 14, p. 30).

Flight 512, commanded by Capt. E. J. Bechtold, ALPA safety spokesman, encountered fog near the threshold of runway 4R, attempted a go-around, but struck the ground in a slightly nose high attitude, according to a CAB accident investigation report. A total of 24 passengers and two stewardesses survived the impact and subsequent fire.

ALPA immediately challenged the Board's findings as "misleading." The association claimed that the crew was unable to avert the crash because it had not been informed of the runway weather conditions.

Radio Contact

Reviewing events preceding the accident, CAB said the last radio contact with the flight was at 9:43 p.m. shortly after it had passed the outer marker and had been cleared to land. The crew had agreed to the tower dimming the approach light system. Another Eastern flight that landed 1 min. after this radio contact reported thick fog patches along the runway.

Flight 512 failed to report sighting the middle marker, although two tower controllers saw the aircraft's red rotating beacon disappear in fog about ½ mi. from the end of the runway. At 9:44 p.m. the tower requested that flight 512 advise when it was clear of the runway, but received no response. One minute later tower controllers saw a bright orange flash near the precision approach radar building, located about 400 ft. to the left and 4,200 ft. beyond the threshold of runway 4R. An American Airlines flight, on instructions of the tower, overflew the area and confirmed the crash.

The aircraft's wreckage was found about 2,500 ft. beyond the instrument landing system touchdown point on the left side of the runway. Weather conditions immediately following the accident were reported by the Weather Bureau as "visibility ¾ mi. in fog . . . surface visibility ½ mi."

The Weather Bureau's surface visibility reading was not transmitted to the tower or the aircraft prior to the accident, CAB said.

Although the flight was attempting a landing with tower estimates of ½ mi. visibility, two indications of poor visibility should have been heard by the crew during the approach, CAB said. One of these involved an aircraft that reported a visibility of only 50-60 ft. while clearing the runway and the other was a jet flight that had requested a takeoff delay because of weather conditions.

These transmissions had all taken place on the tower frequency, which Flight 512 had been instructed to monitor before landing, according to the Board.

Nose-up Attitude

Examination of the aircraft wreckage indicated the aircraft was in a 3-to-5-deg. nose-up attitude with landing gear retracted, flaps set at 20 deg. takeoff position and all four engines developing power ranging from 1,890 to 2,035 hp. as compared with 1,000 hp. employed in a normal landing approach, CAB investigators said.

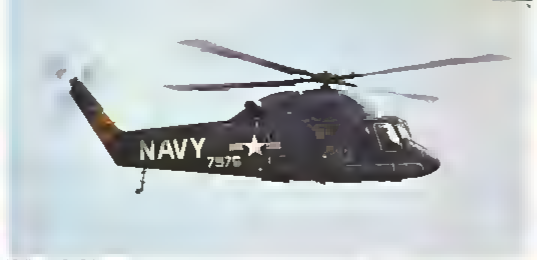
About 9 deg. of aircraft rotation would have been necessary to execute the missed approach, CAB said, or more power should have been used.

"The Board concludes that additional aircraft rotation was not effected due to a lack of immediate instrument orientation and that additional power was either not requested, or delayed because of other duties," the report stated.

Inadequate Report

CAB emphasized that the fog had not been adequately reported to the flight, and pointed out that the Weather Bureau and Federal Aviation Agency had concurred in several recommendations to correct the situations. Among them were recommendations that all terminal area weather conditions be reported to approaching aircraft, runway visibility range (RVR) instrumentation, inoperative at the time of the accident be improved at New York International and that runway observers be employed when the RVR is out of commission.

ALPA contended that its own investigation disclosed that, "the probable cause of the accident was the flight crew's encountering an unreported and intensely dense ground fog condition after the aircraft had been visually placed into a flared for landing condition. This loss of visibility necessitated a return to flight instrumentation reference and the subsequent attempted go-around, in conformance with the applicable manual, was impossible to execute with the reference available," ALPA said.



LEFT HILLER E 4 ABOVE KAMAN UH 2A SEASPRITE

ABOVE BEECHCRAFT MUSKETEER MODEL 23 BELOW NORTH AMERICAN T-39 SABRELINER

ABOVE DOUGLAS NIKE ZEUS BELOW McDONNELL F4H PHANTOM II

CONTROL

PERFORMANCE-PROVED...

Why these switches and power relays are first choice of the aerospace industry

Cutler-Hammer switches and power relays have earned a position of leadership by demonstrating their reliable performance when and where it counts — on the nation's leading aircraft! Their outstanding performance has been proved on thousands of military and commercial aircraft, in space and ground-support applications . . . leadership dating back to 1920 when Cutler-Hammer created the first line of switches specifically designed for airborne application.

What's more, aerospace manufacturers know about Cutler-Hammer's approach to reliability. Reliability is designed and built in . . . not merely tested for after the device is produced. Constant in-process inspecting and 100% testing during assembly assures adherence to our own exacting specifications. Mil Specs are our minimum design goals!

What does it all mean? Whether it's a switch, a circuit breaker, or a Class 0 or hermetically sealed power relay—you're assured of Cutler-Hammer's years-ahead design, manufacturing excellence, consistent quality, positive performance and immediate availability every time.

Need a special switch or power relay to solve a particular problem? For really fast service, call your nearby Cutler-Hammer sales office. There's one in every major city. And for detailed information on our complete line, write for a new 40-page catalog, publication LU-526.

WHAT'S NEW? ASK

CUTLER-HAMMER

Cutler-Hammer Inc. Milwaukee Wisconsin • Divisions: AIL Thayer Scale • Subsidiaries: Unifilus, Inc. Cutler-Hammer International, C.A. • Associates: Cutler-Hammer Canada Ltd. Cutler-Hammer Mexicana, S.A.

CONTROL

PRELIMINARY ORDER for 130 of the Saab 105 trainer, shown above, rear, in first flight photograph, has been placed by Swedish Air Force subject to acceptance tests later this year. Two-place Draken J35F all-weather fighter interceptor is in foreground.

Viggen to Be Core of Swedish Air Force

By Warren C. Wetmore

Stockholm—Swedish Air Force plans to replace all present first-line combat and reconnaissance aircraft with the Saab 37 Viggen by the mid-1970s, and increase its reliance on a variety of missile systems.

First aircraft scheduled for phase-out in favor of the Viggen is the Saab A32 Lansen strike fighter, all of which will be retired by 1970. Longer service is scheduled for the Saab Draken all-weather fighter-interceptor which in its latest version, the Falcon-armed J35F, is considered an adequate mainstay for Sweden's air defenses up through 1975.

Metal Cutting

Metal cutting was begun at Saab Aircraft Co's Linkoping plant for the first Viggen prototype, which is slated for rollout and flight testing in the late 1965-early 1966 period.

Physically, the Viggen will be somewhat larger than the Draken and is designed to "surpass the whole flight envelope" of that airplane, Lars Brising, Saab's director of engineering, said.

Recognizing the peril inherent in having too many of its expensive combat aircraft concentrated in a few localities in the nuclear age, the air force sought a solution to the problem of adequate dispersement. Studies showed that a VTOL aircraft would have to be half again as large as a STOL to produce the same ground attack capability. It was decided best for Swedish purposes to design the Viggen for STOL performance, so it could operate out of the small, relatively primitive airfields scattered throughout the country.

The Viggen will require appreciably less runway than the Draken, Brising said. Touchdown speed lower than the Draken's 125 mph will be facilitated by blown boundary layer control on the flaps of the aircraft's unusual forewing. Air for this purpose will be supplied by compressor bleed.

Angle of incidence on landing will be somewhat greater than that of the Draken, which touches down at 12 to 14 deg., but the Viggen is designed for this and landing safety will not be adversely affected. Its raised cockpit is situated well forward of the forewing and the nose is dropped for additional downward visibility.

Forewing has a clipped delta planform and will be located close to the aircraft's center of gravity. It is designed to give controlled vortex flow over the main wing, which in turn will yield a continuous slope of the coefficient of moment versus angle of attack curve and thus improve the aircraft's stability. In addition, favorable interference of shock patterns between the wings will occur at supersonic speeds.

Planform is the double delta pioneered in the Draken, except that the sweepback pattern is changed. Forward of the break, the wing has a lower sweep angle than that after the break, reverse that of the Draken.

Ventral fin opposite the tail is designed to give symmetry to the aircraft's vertical surfaces.

The Viggen will be powered by a supersonic version of the Pratt & Whitney JT8D turbofan engine fitted with an afterburner. Its powerplant, bearing the Swedish designation RM 8, will be built under license by Svenska Flygmotor AB of Trollhattan (AW June 4, 1962, p. 37). The U. S. designation is JT8D-22.

Military Versions

Dry thrust of the JT8D-1, which powers the Boeing 727 jet transport, is 14,000 lb. While no official figures are available on the military version, some Swedish sources have indicated that it will be rated at about 24,000 lb. dry. Afterburning will boost this by about 70%. Installed weight of the engine is about 7,850 lb.

It was selected because of its low specific fuel consumption, a highly important factor on long-range, low-level strike and reconnaissance missions. On the other hand, the high thrust augmentation with afterburning suits it for fighter-interceptor application, which requires high speed and rapid acceleration.

A Saab-built thrust reverser on the

engine will help in landing on short, ice- and snow-covered runways during the long, cold Swedish winter.

Basic internal armament of the Viggen will be up to four 30 mm. cannons. The A37 strike fighter version will also carry external stores of bombs, mines and unguided rockets. Its Rb 304 missile will be used against naval targets (AW Mar. 3, 1958, p. 309).

Another air-to-surface missile officially unnamed as yet has been under development by Saab for about five years. Designed for use against both land and sea targets, it will feature automatic all-weather homing plus greater range and destructive power than the Rb 304.

The missile is reported to have four highly-swept wings and control surfaces near the aft end.

Fighter-Interceptor

An all-weather fighter-interceptor version of the Viggen will be armed with Hughes Falcon air-to-air missiles or their equivalent. Aircraft will be completely integrated into the STRIL 60 semi-automatic air defense system (AW Mar. 7, 1960, p. 299).

A miniaturized solid-state digital computer on board the Viggen will ease the pilot's workload. The Saab-designed and -built device—about the size of a transistor radio—will perform navigation and position determination tasks; fire control and armament calculations; fuel status monitoring; automatic control of the aircraft and data exchange with the STRIL 60 ground-based computers.

Operating speed of the computer is 100,000 additions per sec., and its rapid-access memory has a capacity of more than 8,000 words. Input-output sections are designed to handle both digital and analog signals and have a substantial growth potential.

Computer Advantages

One of the prime advantages of a digital computer over an analog computer such as the one now flying in the Draken is ease of reprogramming without physically altering the unit. Flexibility of the aircraft can be increased greatly by changing its electronically-stored program to introduce the latest situation, test results and tactics.

Modular construction is employed in the computer to facilitate maintenance, with frames that can be swung out for access to components.

Long-life planar silicon components are utilized as the semiconductor elements.

The Swedish Air Board is responsible for technical and financial management of System 37. It has laid down new procurement guidelines in order to best utilize the available resources, both in industry and in the Air Board itself. As System 37 prime contractor, Saab will coordinate procurement under Air Board supervision, making sure that equipment meets specifications and is delivered at the proper time and fabricated within the fixed economic boundaries. In contrast to the previous arrangement in Sweden, where nearly all materiel was developed to the Air Board's direct order, System 37 components will be developed and procured largely to Saab's order.

PERT in Use

To facilitate chronological coordination of the work on System 37, Saab made a detailed, two-year study of the U.S.-developed Program Evaluation and Review Technique (PERT), and used it experimentally in connection with the Saab 105 jet trainer. Presently PERT is being used for planning and follow-up on System 37, and is expected to be a valuable tool as the program advances.

Draken versions now rolling off the line in Linkoping are the J35D and S35E, the latter having a modified nose section for accommodating aerial reconnaissance cameras (AW Jul. 15, p. 30). These Mach 2 aircraft are powered by Rolls-Royce RB.146 Avon 300 engines built under license by Svenska Flygmotor.

Drakens are currently armed with two or four U.S.-built Sidewinder missiles or 38 podded 7.5 cm. Bofors air-to-air rockets.

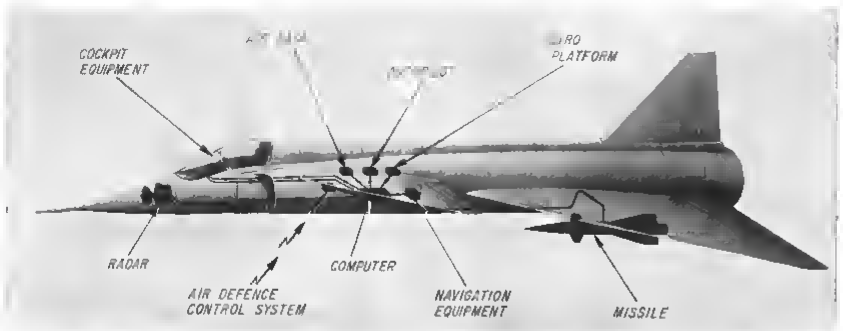
Final planned version, designated the J35F, will enter Sweden's air defense arsenal on a fully operational basis early in 1965. Aircraft will be procured in greater number than any of the preceding versions and production will extend through 1968. Prototype tests, using two converted J35Bs, began in 1961.

Primary difference in the J35F is the installation of an advanced version of the Saab S7 collision-course fire-control system, plus a more powerful reconnaissance/fire control radar designed and built by L. M. Ericsson Co.

Falcons Used

J35F will pack a one-two punch of four Falcon air-to-air missiles of two different types:

- **Falcon Rb 327 (HM-55)** uses radar guidance and can be used in any weather but is limited at very low altitudes. It resembles the GAM-11 Nuclear Falcon, and was specially designed to Swedish specifications. The high explosive warhead is detonated by a proximity fuse. Mounting is on two belly racks adjacent to the break in the aircraft's wing.
- **Falcon Rb 328 (HM-58)** has a collision-course infrared homing system as



MINIATURIZED, SOLID STATE computer eases pilot workload on Swedish Air Force's Saab 37 Viggen. Computer location is indicated on this sketch showing its links with vital components

opposed to tail-chase IR guidance. While severely restricted by rain and dense clouds, the missile can be launched at treetop level. Contact fuse requiring a direct hit on the target is used. Cost of the unit is said to be considerably lower than that of the radar-guided Falcon, so the IR missile probably would be used whenever conditions—such as very high altitudes, favor either missile. It is carried on outboard wing pylons.

Both missiles are being produced under Hughes license by Saab in Linkoping.

Like the other Draken versions, the J35F has mountings under the wings and is readily adaptable to the ground attack mission. Usual armament in this configuration is either 12 Bofors 13.5-cm. rockets, nine 220-lb. bombs or two 1,100-lb. bombs in addition to the aircraft's two 30-mm. cannons.

Owing to this multi-mission capability, the Swedish Air Force considers its manned aircraft more important than surface-to-air missiles. Nevertheless, a number of Bristol Bloodhound I missiles were bought three years ago for training and evaluation. They lived up to expectations and are now on operational alert. The second generation version, the Bloodhound 2, will be procured this year for deployment around vital targets. Installations are being constructed now, and the system is scheduled to be operational by the end of 1964. Bloodhound 2 squadrons also will be under control of STRIL 60 and will be employed against fast intruders at altitudes above 65,000 ft.

The air force has placed a preliminary order for 130 Saab 105s, subject to fulfillment of specifications during aircraft acceptance tests to be held later this year. Deliveries are scheduled to begin in early 1965. The aircraft is slated to replace the de Havilland Vampire as an intermediate jet trainer.

The Saab can be quickly converted to a light ground attack aircraft by fitting it with external store mounts. In this mission it will be used to complement the vastly more expensive Viggen A37 during the next decade. Targets will be divided according to capability: the 105 will attack enemy beachheads while the faster, longer-range A37 will blast the invasion fleet and range far into enemy territory, attacking supply lines, air bases, radar installations, communications centers and other tactical targets of a tactical nature.

A need is felt for nuclear weapons, according to one military spokesman. Such weapons would be limited to tactical size in conformity with Sweden's traditional defensive military posture. Strategic retaliatory arms for the air force are not desired, even though they probably could be delivered by the Viggen.

Swedish development in this area would be hampered by the nuclear test ban treaty. In the end, however, the decision will be a political one. The incumbent Socialist Party is scheduled to determine its position on the issue next year. Conservatives have sided with the military on the question, but the Liberal Party is as yet undecided. The expense of nuclear arms and the possibility of escalation if they were used in combat are likely to be of strong influence on the final decision.

At the present time the Swedish Air Force is organized into four operational aircraft groups:

- **Group 1** is composed solely of strike aircraft divided into four attack wings of 12 squadrons.
- **Group 2**, entrusted with the defense of southwest Sweden, numbers three wings of day fighters and one all-weather fighter wing, with 11 squadrons.
- **Group 3** defends the central and eastern portions of the country with a mixed force of one ground-to-air missile wing of two squadrons and four A/W fighter wings of 12 squadrons. This is by far the strongest air defense group in the air force, and its location is indicative of Sweden's concern over the threat to its industrial heartland from the Soviet-occupied countries of Latvia, Lithuania and Estonia, situated just 250 mi. away across the Baltic Sea.
- **Group 4** anchors Sweden's northern defense perimeter with one wing of day fighters, one reconnaissance wing and one combined reconnaissance-A/W fighter wing totaling nine squadrons.

In addition, the air force operates three main overhaul and repair bases and a flight training school, a bombing school, a radar and missile training school, an officer training school and smaller training centers in technical subjects.

Recently, the air force trend was toward a decreasing number of aircraft as the cost of modern airborne weapons systems soared. Five day-fighter wings—fully 25% of the total aircraft—were lopped from the roster between 1958 and 1960. These were mainly obsolete J29 Flying Barrels, of which 30 were sold to Austria.

With a total strength of 44 squadrons each having 12 committed aircraft, the Swedish Air Force today has approximately 530 combat-ready aircraft excluding those held in reserve and those on maintenance. This number is likely to remain more or less steady as the day fighters are replaced by Drakens.

Replacement schedule calls for the retirement of all J29s within one year. Another year will see the phase out of the remaining Hawker Hunter squadrons, after which air force fighter interceptor units will consist only of all-weather Lansens and Drakens. Lansens will be the last to be superseded by the Drakens.

Air force's slice of the current $725 million defense budget is $277 million, or about 38% of the total. That figure represents an increase of nearly 10% over last year. The rise is likely to become steeper as the new J35Fs—at a unit cost of about $1.2 million—and the various missile systems are procured.

Total price tag for System 37 is reportedly about $600 million, pointing to an even sharper upward trend in the 1970s.

In peacetime, the regular Swedish Air Force has a personnel quota of 1,050 commissioned officers, 1,400 warrant officers and 3,300 non-coms and enlisted men. There also are 6,700 men performing required military service, 100 WAFs and about 6,750 civilian employes.

The seemingly large number of warrant officers is explained by the fact that all short-service pilots—those serving the minimum six years, which includes most combat pilots—are of that rank. These men could arbitrarily be made commissioned officers, but air force policy dictates that officers be usable in non-pilot situations.

Recruitment of more career officer-pilots and de-emphasis of the short-service contracts now is desired.

Between 150 and 200 men, including both short-service men and officer candidates, are receiving pilot training annually.

All pilots are trained for combat. At the air force's Flight School in Ljungbyhed they receive 20 hr. of primary training in Saab Safirs, followed by 130 hr. of jet instruction in de Havilland Vampire trainers. Jet solos are flown after 15 to 20 hr. From there they proceed to the various combat wings or, if selected, to Draken type-training school. Washouts are said to account for some 50% of those men initially accepted as aviation cadets.

Inventory Reduction

Air Force Logistics Command reports its inventory reduction programs including Project MINT (AW Nov. 26, p. 103) have reduced the Air Force inventory by a net of 275,000 items despite the addition of about 400 new items daily.

For the first year of its operation, ended August 1963, Project MINT (Material Identification and New Item Control Techniques) is credited with reducing the federal catalogue file by 322,000 items out of a total of 420,000 items withdrawn.

The Air Force inventory had been reduced from an all-time high of 2,140,000 items in June 1962 to 1,665,000 items by August 1963.

Eight Marks Claimed For Vostoks 5 and 6

Moscow—Soviet Union has announced it has filed claims for eight world records with the International Aeronautical Federation as the results of the flights of Lt. Col. Valery Bykovsky in Vostok 5 and Junior Lt. Valentina Tereshkova in Vostok 6.

Russia claims two orbital class and two absolute records for Bykovsky duration, 119 hr. and distance, 2,062,120 mi. World records for Miss Tereshkova are claimed for flight by a woman in duration, 71 hr., altitude, over 143.2 mi., distance, 1,222,020 mi., and pay load in orbit, 10,369 lb. The class and absolute records are held by Russia, and the women's class records are new.

In technical documentation accompanying the record claims, Russia said the total thrust of the Vostok 5 and 6 launch systems was 1.2 million lb.

PRODUCTION BRIEFING

Thiokol Chemical Corp., Bristol, Pa., has a $3.7-million Air Force contract for qualification testing and production of motors for the Genie air-to-air missile. Thiokol's previous Genie contract called for development and demonstration of a propellant meeting Genie's ballistic specifications and extreme operational temperature range.

Lear Siegler, Inc., Santa Monica, Calif., has a $7.6-million follow-on contract from McDonnell Aircraft Corp. for flight reference and bombing systems of F-4C aircraft. The system provides the pilot with a visual display of his position relative to the earth and a series of commands necessary to execute the bombing maneuver.

Bureau of Naval Weapons has exercised its option for $31 million in additional Boeing Vertol CH-46A Sea Knight helicopters for the Marine Corps.

Martin Co.'s Orlando Div. has received a $27.7-million Army contract for additional engineering services for the Pershing ground-to-ground mobile weapons system.

General Dynamics/Pomona has been awarded a $1.1 million Army contract for continued development of the Redeye surface-to-air missile system. Redeye is used as a troop weapon against low flying aircraft.

Bell Helicopter Co., Ft. Worth, Tex., has received a $2.7 million order for an undisclosed number of Bell UH-1E assault support helicopters for the Marine Corps. The order brings the total value of the Marine contract for the helicopters to over $57 million since last January.

United Air Lines will pay $1.7 million for Douglas DC-8 replacement seats to Aerotherm Div., Acrotec Industries Inc., Bantam, Conn. The seats will be used to equip United's DC-8s with five abreast seating for its one class service. Seats will be equipped with passenger air and oxygen facilities, lights and a patented energy absorption system. Deliveries start in early 1964.

Bureau of Naval Weapons and Hercules Powder Co. have changed the management arrangement of the Navy-owned Allegany Ballistics Laboratory, Cumberland, Md. All work since 1946 has been done under a single Navy contract. Government agencies and prime contractors desiring to begin rocket propulsion programs at the laboratory had to contract with the Navy. The new arrangement allows other government agencies and prime contractors to deal directly with Hercules for work at the laboratory.

Instrument Div. of Lear Siegler, Inc., Grand Rapids, Mich., has a $170,000 Boeing contract to design, develop and build rate of climb indicators for the Air Force X-20 (Dyna-Soar) manned space glider.

AFOSR Awards

Grants for more than $400,000 were given recently by the Air Force Office of Scientific Research to universities and research firms in the United States.

They were:

University of Texas, Austin—$14,251 for basic research in numerical and applied functional analysis.

Colorado State University, Fort Collins—$1,409 for research on statistics for geologists.

Northwestern University, Evanston, Ill.—$95,974 for the study of structure sensitive properties of intermediate solid solutions.

University of North Carolina, Chapel Hill—$112,382 for an investigation of imperfections of ionic crystals.

Kansas State University, Manhattan—$20,100 to study heat transfer in a MHD fluid.

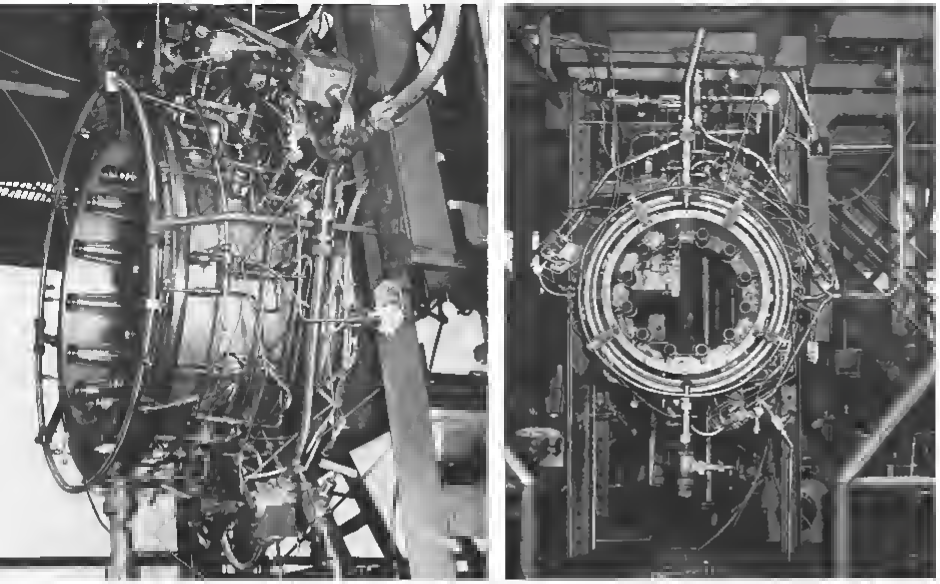
Stevens Institute of Technology, Hoboken, N. J.—$82,478 to investigate mechanism and dynamics of coaxial plasma acceleration.

American Society of Mechanical Engineers, New York, N. Y.—$15,000 for research on applied mechanics reviews.

University of Washington, Seattle—$24,043 to investigate machine learning for general problem solving.

Rockford Research Institute, Cambridge, Mass.—$15,916 for research on information system configuration and $18,581 for study on theory of methods for implementing inductive inference.

Lehigh University, Bethlehem, Penn.—$4,650 to investigate mathematical models for information storage and retrieval systems.



TEST SETUP of 12 scale model engines to be used in a joint USAF-NASA program to determine the feasibility of augmenting a space booster's thrust through a shroud. Note nozzles of test engines within perimeter of shroud. Tests will begin later this month.

NASA-USAF Test Thrust Augmentation

Huntsville, Ala.—National Aeronautics and Space Administration and Air Force will begin a joint experimental test program later this month to investigate the thrust augmentation provided a rocket booster by the addition of an air scooping shroud around the base of the vehicle.

Similar in appearance to the shrouded turbojet or ducted propeller of aircraft, the shroud is designed to increase the mass flow exhausted from the base of the vehicle. Air scooped in by the forward end of the shroud is mixed with the exhaust gases of the engines and then expanded and accelerated from the aft end of the shroud.

Theoretical Calculations

Theoretical calculations made by NASA's Marshall Space Flight Center, the USAF and the Martin Co.'s Denver division, contractor for the test program, show that an optimum shroud design could increase the thrust of a vehicle by a factor of 1.5 to 2.8 times.

Where previous rocket engine shroud experimentation has used single engines in individual shrouds, NASA-USAF's approach is to use one large diameter shroud enclosing a cluster of engines. This approach appears to promise good mass flow rates without resorting to extended lengths in the duct.

In earlier shroud work, NASA personnel say, the duct had to be so long to be effective that its weight negated any performance gain. Using multiple engines and a wide diameter shroud, the agencies believe that length/diameter ratios of 1 or less are not impossible.

Scaled-Down Engines

In this program, NASA and USAF are using 12 scaled-down engines in an annular configuration. That number was selected as the best quantity to produce certain desired flow rates through the shroud.

Each engine produces a 500-lb. thrust and is a 1/58 scale model of the 1.5 million-lb.-thrust F-1 engine in some operating characteristics, such as chamber pressure and area expansion ratio. Buried in smooth aerodynamic pods, the engines are pylon-mounted every 30 deg. apart along the inner wall surface of the shroud.

This is purely a research and development type of installation and was selected for ease of propellant handling during testing in wind tunnels.

The shroud surrounds a 16-in. dia. center body. This unit, with a conical aft end, simulates the main airframe of a launch vehicle. Its aft end provides the effect of a plug engine on the gases flowing in the lower region of the shroud.

Several shroud configurations will be tested. At least one will be convergent in shape, while the others will be divergent. Fabricated of conventional steel, the shrouds to be used in this scale test program will vary between 45 and 60-in. in length and 32 to 36-in. in dia. For length/diameter ratios between 1.2 and 1.8 shrouds will be tapered slightly, like truncated cones, and will have no flair at the base.

Inlet Geometry

Inlet geometry of the shrouds is fixed, since USAF and NASA did not want to complicate the program unnecessarily with variable inlets. Density of the air flow passed through the shrouds in the wind tunnels of USAF's Arnold Engineering Development Center, Tullahoma, Tenn., will be varied to simulate the ever decreasing density of air encountered in an ascending trajectory.

AIR-SCOOPING SHROUD being tested by USAF and NASA scoops air at forward end. Air is mixed with engine exhaust gases and is expanded and accelerated from aft end.

Offered by Air-Scoop Shroud

One of the prime objectives of the 120 firings now planned for the program will be the determination of an optimum fixed inlet area for a vehicle of given thrust operating between sea level and varying altitudes up to approximately 30 mi.

In operation, air would flow between the shroud and centerbody and be compressed to a pressure level slightly higher than that of the exhaust from the 12 engines. Flowing subsonically past the engine pods, the air then would pass into the larger volume of the lower half of the shroud, where it could mix with the exhaust gases of the thrusters, expand and be accelerated. Flow of the augmented mass out the rear of the shroud should be at a velocity of about Mach 1.

Greater Mixing

To ensure greater mixing of air with exhaust, it is planned to install vortex generators toward the forward end of the shroud. Flow past the engines would be turbulent and, being anywhere from 2 to 5 psi. higher than the exhaust, would mix evenly throughout. Marshall engineers say that although some secondary combustion is likely to occur when oxygen in the air contacts the hot exhaust of the engines, the program is not relying on this phenomenon as a component in the augmented thrust.

Simple transfer of heat from the exhaust to the relatively-cooler air should be sufficient to expand and accelerate the latter.

Ratio of the augmenting mass flow to the exhaust flow is planned to be between 2-to-1 and 4-to-1, compared with the 20-to-1 ratios attempted in the past with single engine/single shroud tests.

This lower weight flow, say Marshall engineers, lessens the inlet requirements of the shroud and consequently reduces the drag of the duct.

The initial series of tests at Tullahoma will disregard the weight and drag of the shroud, although it is clearly recognized that these factors could cut approximately 20 to 30% from any performance increase obtained through the shroud.

Initial Tests

If the initial tests look encouraging, the agencies might experiment further with several refinements on the basic concept—including the addition of fuel injectors in the forward area of the shroud, upstream of the podded engines. Fuel would mix with the turbulent air flow before diffusing with and burning with the hot, oxidizer-rich exhaust of the engines. Although similar to an approach taken by Pratt & Whitney Aircraft in its research on high pressure engines (AW Sept. 23, p. 73), this technique would make the vehicle a true rocket ramjet, according to Marshall engineers.

Program was initiated by USAF's rocket test facility at Edwards AFB, Calif., last June. Marshall was invited to participate in the program, since it had available the scale engines. Martin's contract is for approximately $100,000.

Soviet Article Derides U. S. Lunar Effort

Moscow—Comprehensive review of the U. S. lunar exploration program published by the Russian magazine Aviatsiya i Kosmonavtika (Aviation and Cosmonautics), an official Red Air Force organ, manifests considerable scorn for American efforts. The article says:

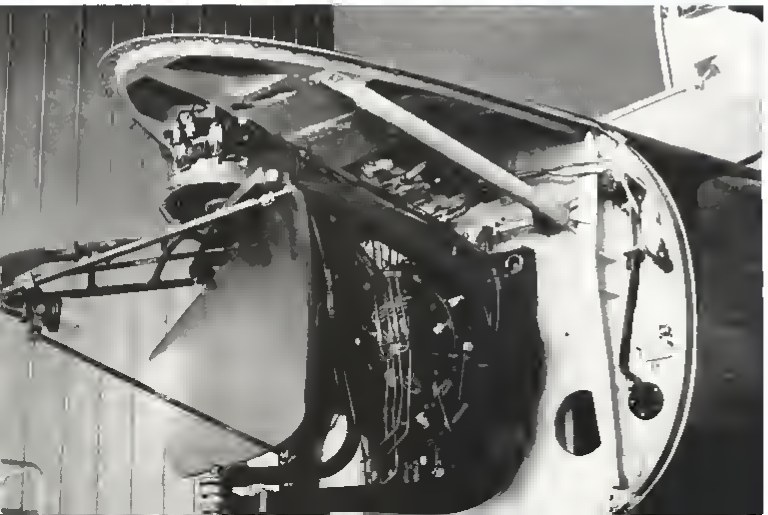
"Press reports show that the American moon program is vulnerable in many places. First of all, existing and future [U. S.] carrier rockets have obviously inadequate thrust.

"As long ago as April 1961 the Soviet Union achieved the power level for carrier rockets which the United States is planning to reach in 1964-1965, after the Saturn 1 is placed in operation. Cabins of existing and future space ships are not suitable for prolonged flights.

"The program has been put together on the basis of the most optimistically short periods for design and production of a large number of very complex components. Neither U. S. scientific-research organizations nor the American aerospace industry has any experience at all regarding most of these components.

"The slightest delay in building any of the subsystems will lead to disruption in the schedules for all related projects."

The Soviet report ignored Russia's space failures—including at least seven unmanned planetary missions and one unmanned lunar probe which were launched during the last 18 months.



Conceptual illustrations of: (Top left) Airborne surveillance-and-command system (Top right) Integrated mapping, terrain-following, and airborne target-detection radar.

Left: B-58 bombing/navigation radar — an example of Raytheon's proven capability in the development and production of precision radars.

NEW AVIONIC CONCEPTS
for Advanced Weapon Systems-from Raytheon

At Raytheon, radical new solutions to problems of multi-mode antenna design, ground clutter elimination, electromagnetic penetration, and optimized digital data techniques, are making important contributions to advanced weapon systems technology.

Backed by more than 15 years of successful ECM, guided missile, radar and avionics experience, Raytheon is applying new techniques to a wide range of advanced avionic systems. Typical examples include: an integrated mapping, terrain-following, and airborne target-detection radar for light attack aircraft — an airborne surveillance-and-command system featuring a long-range sensor to detect a variety of small targets "buried" in ground clutter — and a precision radar for accurate navigation, weather detection at jet altitudes, and approach monitoring.

For more information about these and other new Raytheon avionic developments, write: *Neil A. Montone, Director of Marketing, Raytheon Company, Space and Information Systems Division, Bedford, Massachusetts.*

RAYTHEON

Project Fire Package Undergoes Vibration Test

Vibration test program conducted by Ling-Temco-Vought on the Project Fire velocity package provides first picture of the high-speed re-entry project, which will carry an Apollo-shaped payload through the earth's atmosphere at 25,000 mph. following launch by an Atlas D to altitude from Cape Canaveral. Following separation from the launch vehicle, the velocity package will be thrust downwards for re-entry by its own Antares 2 solid rocket. Project Fire package is about 14 ft. long and contains a Republic Aviation-built payload. Ling-Temco-Vought has delivered initial packages to NASA.

Biosatellite Experiments Chosen

Moffett Field, Calif.—First phase selection of experiments for flight in the National Aeronautics and Space Administration's Biosatellite is nearing completion, with 49 experiments chosen for development from a total of 150 that were proposed. Biosatellite experiments studying basic biological functions in a weightless environment will involve up to 30-day earth orbits of recoverable flight payloads.

Selection of the 49 experiments has been made by the Biosatellite project office here at Ames Research Center. It had the concurrence of the biosciences subcommittee of the space sciences steering committee, the group responsible for selecting NASA's scientific experiments. Formal designation of the 49 experiments chosen to date, and the possible addition of others from about a dozen which the project office has requested the subcommittee to review, is expected at the December meetings of the subcommittee and the steering committee.

First phase funding now being distributed where called for is to help develop an automated breadboard of proposed experiments so that requirements for flight hardware can be defined. Experiments must remain scientifically sound in the automated system required. Engineering acceptability and feasibility, including demands on the spacecraft life support system, will have to be demonstrated.

Selection of experiments for the next phase of development—preparation of a flight prototype experiment—will be made in the third quarter of 1964. This phase is expected to consume approximately one year, with flight hardware to be ready for the first Biosatellite flight in the fourth quarter of 1965. NASA hopes to launch subsequent flights at three month intervals. Six flights are planned.

Final Selection

Experiments chosen for the first phase development must still compete for final selection. In some key areas of investigation there is duplication, to provide back-ups in case some experiments cannot be automated. Experiments will involve monkeys and other animal and plant specimens.

Five general areas of investigation planned for the Biosatellite "weightless laboratory" include experiments involving mammalian physiology, general biology, radiation biology, plant growth and biological rhythms.

Of the 49 experiments selected by Ames to date, seven were proposed by industry, 24 by universities, 10 by the Atomic Energy Commission, five by NASA, two the Air Force and one by the Navy. Most experiments being handled by government agencies involve a transfer of funds rather than contract awards.

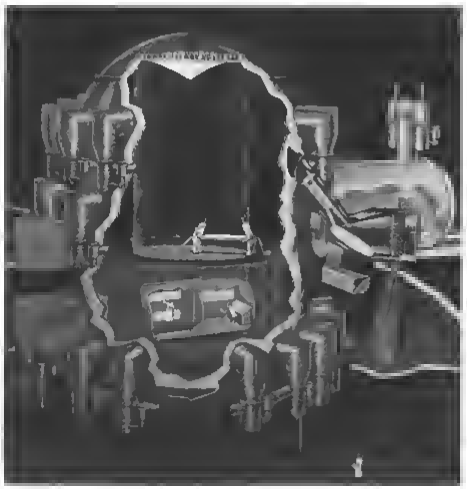
Corporate Awards

The seven corporate experiments and the amount of respective awards are as follows:

- **Avco Corp. Research and Advanced Development Div.**—orbiting effects on bioluminescent and other rhythmic fungi—$76,759.
- **General Electric Missile and Space Div.**, two experiments—on the effect of weightlessness on the rhythmicity of photosynthesis and bioluminescence in dinoflagellates grown in liquid media, $99,490, and on nutrition and growth in pelomyxa carolinensis during weightlessness—$46,590.
- **Goodyear Aircraft Corp.**, behavior and reproduction of paramecia in a weightless state—$75,950.
- **North American Aviation Space and Information Systems Div.**, two experiments on effect of weightlessness in development of chick embryo—$44,608.

SOLID PROPELLANT PRODUCTION FACILITY—U S. AIR FORCE PLANT #78 *Lummus architect/engineering design for this propellant complex included auxiliary facilities for MINUTEMAN horizontal engine testing, propellant handling and storage considerations, and rocket-engine handling.*

PROCESS ENGINEERING MODEL, U.S. NAVY PROPELLANT PLANT, NITROPLASTICIZER UNIT *In addition to process design for nitroplasticizer unit, Lummus performed design functions for conversion of the unit from batch to continuous process, for a slurry-casting plant to produce intermediates for possible fuel application, and for attendant instrument-maintenance facilities.*



LUNAR ENVIRONMENTAL RESEARCH FACILITY—U.S. ARMY CORPS OF ENGINEERS *Lummus performed the conceptual engineering for this simulator which established the engineering feasibility to provide for vacuums up to 1×10^{-8} torr, temperatures as low as –423°F, and solar radiation twice the intensity of the noonday sun—up to 130 watts/sq ft.*

WORLD'S LARGEST LIQUID HYDROGEN PRODUCTION FACILITY—U.S. AIR FORCE PLANT #74 *Lummus designed, engineered, and constructed the hydrogen-production process phases of this plant to produce 99+% pure hydrogen, which is then liquefied through cryogenic processes.*

Lummus serves the Aerospace Industry

From technical feasibility studies to detail architect/engineering and construction services, The Lummus Company serves the aerospace industry with a high degree of professional competence. Lummus' vast experience in the architect/engineering and construction of nearly 1,000 major industrial and process plants for industry and Government throughout the world has created a staff knowledgeable in cryogenics, metallurgy, liquid and solid propellants, nucleonics, chemicals, physics, radiation physics, high vacuum technology, and solar simulation.

For creative engineering, skillful project management, and on-time construction—consult Lummus.

THE LUMMUS COMPANY 385 Madison Avenue, New York 17, N. Y.

Government Operations Office: 1001 Connecticut Avenue, Washington 6, D. C. Offices and subsidiaries: Newark, Houston, Montreal, London, Paris, The Hague, Madrid, Milan, Bombay, Tokyo. Engineering Development Center: Newark.

ARCHITECT / ENGINEERS AND CONSTRUCTORS FOR INDUSTRY AND GOVERNMENT

AEROSPACE · NUCLEAR · CHEMICAL · PETROLEUM/PETROCHEMICAL · AGRICULTURAL CHEMICAL · PULP & PAPER · METALLURGICAL · SYNTHETIC FIBERS · PHARMACEUTICAL · FOOD PROCESSING · RESINS & PLASTICS

and a study of tissue regeneration and wound healing during weightlessness—$28,364.

• **Space Labs**—Dynamic monitoring of the cardiovascular system in weightlessness—$25,951.

Only 15 of the university contract grants have been fully negotiated up to now.

Some of the largest of these grants, the experiments and principal scientists are these:

• **Monitoring brain functions** and performance in the monkey under prolonged weightlessness—W. R. Adey, U. of Calif. at Los Angeles—$92,394.

• **Primate hemodynamics** and metabolism under zero g—Nello Pace, U. of Calif. at Berkeley—$80,368.

• **Study of psychocardiovascular reactions** under weightlessness—H. Ridgeley Warfield, Johns Hopkins U.—$60,000.

• **Study of renal** and vascular changes produced by weightlessness—W. D. Collings, Mich. State U.—$56,297.

• **Spectra and cross-spectra** of metabolic rhythms (Circadian) in in-bred c-mice as a temporal gage of mammalian performance in extra-terrestrial space—F. Halberg, U. of Minnesota—$42,684.

• **Effect of weightlessness** and other stresses on pathogenicity and immunity—D. T. Clark, Michigan State U.—$43,941.

One additional experiment is for a study of the pathophysiological effects of weightlessness of primates with initial attention to the role of the vestibular organs.

A contract for this experiment for an estimated $100,000 is with the U. S. Naval School of Aviation Medicine, U. S. Naval Medical Center.

General Electric's Re-entry Systems Dept. will develop and produce six flight models of the Biosatellite and a seventh for ground test. Its payload would range from 900 to 1,200 lb., depending on the duration of orbit. A Thor-Delta launch vehicle is specified for the mission, but spacecraft weight may require either thrust augmentation or use of a Thor Agena.

Scientists, Employes Honored by NASA

Washington—U. S. space agency recently honored 23 officials for their contributions to the space program, including presentations for the first time of National Aeronautics and Space Administration Public Service Awards to non-government scientists, and NASA gold medals for exceptional achievement to NASA employes.

Non-government scientists honored were Jack N. James and Robert J. Parks of Jet Propulsion Laboratory for management of the Mariner 2 Venus flyby project and John F. Yardley of McDonnell Aircraft Corp., for managing his company's Project Mercury activities at Cape Canaveral.

Gold medals for achievement were awarded to Dr. Dean R. Chapman of Ames Research Center for research in tektites, entry physics and space mechanics, Dr. Ernst Geissler of Marshall Space Flight Center for his contributions to launch vehicle projects, Dr. John C. Houbolt, formerly of Langley Research Center and now with Princeton Aeronautical Research Associates, for developing the theory of the lunar orbit rendezvous technique for the Apollo lunar landing, Charles J. Donlan, associate Langley director, for his part in organizing and developing concepts for the Mercury and Apollo projects and for astronaut selection, and for continuing manned space flight research technology; Dr. Walter Haeussermann of Marshall, for his work in launch vehicle and spacecraft avionics, and Dr. William A. Mrazek of Marshall, for directing research and development in launch vehicle structures, mechanics, propulsion and materials.

Another 14 NASA employes shared $12,200 in cash awards for aerospace inventions.

AC-2 Flight Will Test Centaur Program

By Michael L. Yaffee

Cleveland—Effectiveness of NASA's new Centaur program management will get its first test shortly with the flight of the AC-2 development vehicle.

Since taking over Centaur project management from NASA's Marshall Space Flight Center one year ago, scientists and engineers here at NASA's Lewis Research Center have made several changes in the program. Most notable of these have been:

- **A five-to-six** fold expansion in ground testing.
- **Simplifications in flight profile** and overall mission requirements.
- **Initiation of studies** aimed at increasing payload capability.

It will be some time before the effects of all the changes being made by Lewis can be fully assessed, but it is possible to review what has and has not been accomplished to date.

The greatly expanded test program, designed to catch most of the development problems on the ground, has led to a lot of late schedules and several changes in the vehicle. So far, the testing has not halted rising development costs or program slippage but is expected to in the near future.

Flight of the second Centaur development vehicle, the AC-2 now at Cape Canaveral, is scheduled for next month (AW Oct. 14, p. 32). This is the fifth revision in the launching date, which was originally in February, 1961.

Cost Estimates Double

Total development cost of the Centaur program, based on the present eight vehicle schedule, is now expected to run close to $520 million—almost double estimates made in the middle of 1961 for a 10 vehicle program.

By the end of Fiscal Year 1963, the government had spent approximately $320 million on Centaur development. For Fiscal Year 1964, NASA has asked $112 million and expects to spend another $85 million before development is completed in 1965.

On the other hand, the expanded ground test program has produced several changes that are expected to increase vehicle reliability. Among the most important of these are changes in the second stage start sequence of the Centaur.

These changes, all checked out in an extensive series of ground tests, are expected to provide many benefits including:

- Faster and more reliable stage separation.
- Some increase in payload.
- A significant shortening of the time during which the vehicle is subjected to the unknowns of zero-g flight.

The new stage separation system, which will be tried on the AC-2, uses a linear shaped charge to cut the welding band mating the Centaur to the interstage adapter and eight retrorockets to back off the empty Atlas and allow the Centaur stage to pull free of the 13-ft adapter section.

On the ill-fated AC-1 (then called F-1) flight in May, 1962, pneumatically actuated latches joined the Centaur to the interstage adapter, and four 50 lb-thrust peroxide ullage rockets were used to push the fully loaded Centaur out of the adapter section.

Old System

In the old stage separation sequence, the Centaur took about 12 sec to pull out of the interstage section and, with the latch system, was more likely to bounce against the adapter. In the new separation system, the Centaur takes only 2 sec to clear the interstage adapter.

In a recent test at Lewis it managed a clean separation under maximum adverse conditions created by the simulated misfiring of one of the eight solid propellant retrorockets girdling the aft end of the Atlas. The linear shaped charge also weighs approximately 25% less than the previously used latch arrangement.

Another important change—also to be flight tested on the AC-2 for the first time is ground chilldown of the RL10 lox hydrogen engines. This technique was checked out in ground tests at Pratt & Whitney's Florida R&D center. Liquid helium is used to cool the RL10 engines to 100 R (−359.7 F) while they are still on the ground.

Airborne Chilldown

During the five min. of boosted flight, the second stage propulsion system temperature rises to 200 R. The system then undergoes an abbreviated airborne chilldown to 150 R to prevent the propellant from flashing into vapor, and the engines are started. Liquid hydrogen from the second stage fuel tank is used for the airborne chilldown and then is vented overboard.

From stage separation to second stage ignition, the new sequence is conservatively figured to take 15 to 16 sec—5 sec. for firing the Atlas vernier engines to stabilize the vehicle after first stage burnout, 2 to 3 sec for Centaur to clear the interstage structure, and 8 sec for airborne chilldown. Lewis engineers hope to shorten this time by 5 sec. or

SKELETAL ATLAS CENTAUR used in stage separation tests at Lewis Research Center is shown before separation. After retrorockets are fired, hooks on the aft end of the Atlas, which is suspended from the overhead trolley, engage the net and keep the Atlas from bouncing back into the mock Centaur stage which remains stationary.

Four-Stage Athena Mockup

Athena four-stage, solid-propellant rocket being developed by Atlantic Research Corp. for Air Force's advanced ballistic re-entry systems (ABRES) program (AW Sept. 2, p. 26), is shown in mockup form. Plans are to launch 77 of these vehicles with payloads consisting of a variety of re-entry bodies and penetration aids. Plans are to launch payloads weighing between 50 and 300 lb. to altitudes up to 500,000 ft., then bring them back through the atmosphere.

possibly more by eliminating vernier engine stabilization and by reducing the time which has been required for airborne chilldown.

By comparison, the original second stage start sequence in which the chill down was carried out completely in the air using onboard propellants required 45 sec.—33 sec. for airborne chilldown, and 5 sec. for vernier stabilization and 7 sec. for clearance of interstage structure.

Among other things, this meant that more propellant had to be used for cooling and then dumped overboard, and that more propellant had to be used to make up the energy lost by the vehicle during this longer period of coasting against gravity.

Simplification of the Centaur flight profile to a one-burn direct ascent to the moon is another important innovation made by Lewis.

Early plans for a three-burn, parking orbit approach were later modified by Marshall Space Flight Center to a two-burn, parking orbit flight.

By going to a one-burn profile, Lewis hopes to obtain a slight increase in payload capability and greater flight reliability by avoiding the problems associated with parking orbits such as the effects of zero g and propellant boil-off.

However, since the one-burn, direct ascent profile narrows the launch window, particularly during the winter, Lewis scientists are seriously pursuing the possibility of returning to MSFC's two-burn program in later development flights.

In the same vein, overall mission requirements have been simplified for the Centaur development program. Centaur no longer has to be all things to all payloads, says NASA's Vincent L. Johnson, Centaur program manager.

Payloads scheduled to hitch-hike on Centaur development flights have been transferred to other vehicles thereby making it possible to hold down costs and, more important, to permit project personnel to concentrate on Centaur itself during this critical development period.

Because of the changes in the Centaur flight profile and in the second stage starting sequence, Lewis engineers believe that they no longer may need the four peroxide ullage rockets designed to keep the propellant tank vapor space on top and used in the original separation procedure.

Ullage rockets in the proposed two-burn flights will be moved from their present positions around the lox tank to the aft end of the Centaur stage between the RL10 rocket nozzles.

In a two-burn flight profile, Centaur would probably park in orbit for 20 to 25 min. Although the exact parking time hasn't yet been established, this period—whatever its duration—is expected to prove a critical one.

To find out what might happen to the vehicle at this time, engineers at Lewis are modifying part of the Space Power Chamber into a vertical space simulator. A complete Centaur second stage will be soaked in it for months at −320F and 10^{-6} torr. It also will be exposed to simulated solar radiation.

Periodically, the Centaur stage will be modified to incorporate new flight configurations. It will undergo a combined checkout of its electrical, hydraulic, telemetry, attitude control and guidance systems.

Lewis engineers strengthened the interstage adapter because tests indicated high potential wind loads and because there are more cutouts in the adapter section now. Among other things, they increased the number of longitudinal stringers in the interstage structure. Weight increased, but because the adapter section stays with the Atlas there will be only a relatively low payload trade-off.

Wall thickness of the liquid hydrogen tank has been increased from 0.010 in. on the AC-1 to 0.016-in. on the AC-2, to make possible better and more reliable welds. But Lewis engineers consider this as only a temporary solution and are investigating the use of chemical milling and improved welding machinery as possible alternatives. They also are considering switching to a material stronger than the stainless steel that is currently being used.

Another weld problem area Lewis engineers hope to remedy in the future is the bracket connecting the interstage adapter, side panels, aft bulkhead insulation and the intermediate bulkhead. This is a complicated welding spot which they plan to simplify and strengthen after the AC-2 flight.

The hydrogen vent pipe on the AC-2 has been redesigned as the result of a series of wind tunnel tests to determine what happens to the hydrogen plume under various conditions of venting.

It will extend farther out from the stage than on the AC-1 to keep it away from the boundary layer and the main engines, and prevent the possibility of the plume igniting. Locking times on the vent valves, which are locked

Beech *"Imaginuity"* in CRYOGENICS

Shirtsleeves environment in space: Beech's job for NASA's Project Apollo

Beech selected to develop and build Cryogenic Storage Subsystem for life support and electrical power

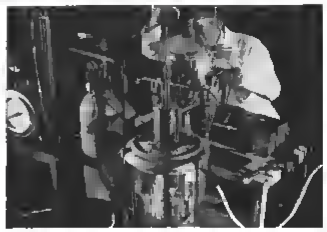
When American Astronsuts embark on their upcoming journey to the moon, they can doff their spacesuits and travel in a comfortable "shirtsleeves" atmosphere. Responsibility for the design, development, manufacture and testing of the storage systems to provide thet atmosphere bas been given to Beech by North American. The same systems will also supply the gases to generate power for the command module.

The selection of Beech for this vital task is based on solid accomplishment and proven reliability. A pioneer in Cryogenics, Beech has been active in the design, development, manufacture and testing of systems and sub-systems for many of our rocket and missile programs.

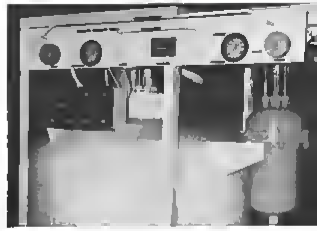
A comprehensive physical facility has been created and staffed by experienced experts. Many of these facilities will be used to fulfill Beech's syatems management responsibilities for Apollo.

Other Beech Capabilities In Systems Management Include:

R & D...

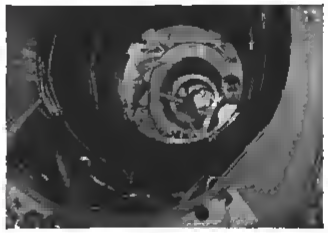


Propulsion...



Auxiliary Power...

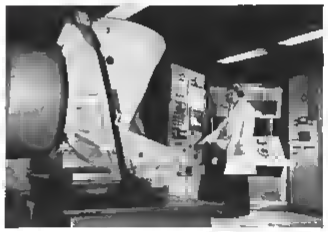
GSE...



Manufacturing...

Space Simulation...

Facilities...



Complex Vibration...

Management...

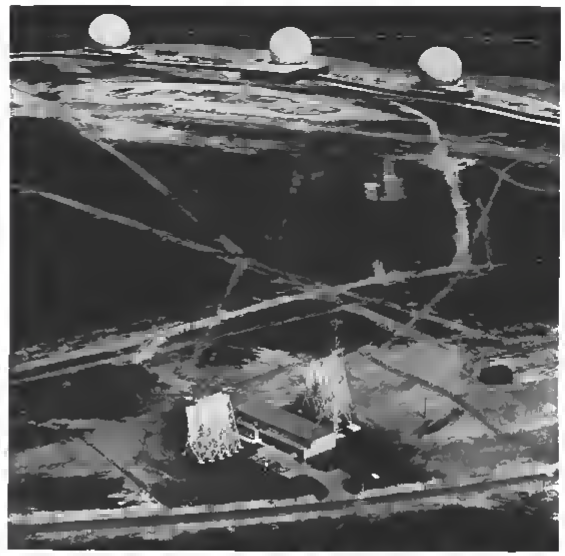
How may we help you? To discover how the unique facilities and expert personnel of Beech can be quickly and efficiently put to work on your project, write, wire, or phone Contract Administrator, Aerospace Division, Beech Aircraft Corporation, Wichita 1, Kansas. Beech stands ready and eager to accept complete systems management responsibility for your project right now.

Beech *Aerospace Division*

BEECH AIRCRAFT CORPORATION • WICHITA 1 KANSAS U S A

HELPING BUSINESS GROW FASTER. Only Beechcraft offers such a complete line of planes with so much speed, range, comfort and quiet to help business multiply the money-making decisions that each top man can make. That's how thousands of Beechcrafts have paid for themselves.

Executives! Write today for: ☐ "Dollars and Sense of Business Flying" ☐ Beech Financing and Leasing plans ☐ New illustrated folders on business-designed Beechcrafts. Address Public Relations Dept., Beech Aircraft Corp., Wichita 1, Kansas, U.S.A.



Fylingdales Moor Radar Site Shown

Aerial view shows the new radar warning site at Fylingdales Moor, Yorkshire, England, which went into operation recently. Three radomes face north and east to permit beaming of their signals over the North Sea. Tropospheric scatter communications installation is shown in foreground.

closed during critical parts of the flight, have been changed for the AC-2 flight.

Slosh baffles similar to those used in the Atlas have been added to the Centaur stage lox tank. Dynamic ground studies have shown that the forces produced by the sloshing of the Centaur's more than 20,000 lb. of lox are more critical than was first calculated and could become high enough to destroy the vehicle. For later vehicles, Lewis is considering lowering the lox tank bulkhead to reduce the available slosh area.

Many changes have been made in the forward bulkhead, once thought to be the source of failure in the first Centaur flight. The flange connecting the nose cone to the forward bulkhead has been strengthened and, at the same time, redesigned to reduce the applied loads on the flange.

Lewis has redesigned the weather shield and greatly reinforced the whole area. But, with all their tests and studies, engineers at Lewis still don't know exactly what caused AC-1 to fail.

The large insulation panels around the liquid hydrogen tanks have been changed on the AC-2 and will be further modified on the AC-3 to improve their structural integrity.

Lewis engineers are changing the thickness of the adhesive used to bond the glass fiber insulation. Steel bands which held the heavy panels on the AC-1 have been replaced with more positive flange type retainers which will be cut away by a shaped charge to jettison the panels. In the AC-2 flight, however, the insulation will be bolted on and not jettisoned.

The guidance system on the Centaur will remain the same, at least for the time being. Lewis project engineers decided that it was the best available but required more testing and improved quality control procedures to ensure its reliability. Studies now under way are aimed at further improving the all inertial guidance system.

In addition to the extensive ground test program and the actual change in chilldown procedures, a noteworthy propulsion development has been the issuance of contracts to study the vehicle's performance and payload capabilities, which have been falling off from the first design figures during the course of the development program (AW Oct. 14, p. 32).

The studies might have a strong influence not only on the Centaur program's future, but on later hydrogen

rocket engine projects and on fluorine aerospace applications in general.

Last April, Lewis awarded the Martin Co.'s Denver Div. a $325,000 contract to evaluate the Titan 2 as a booster for Centaur.

In July, NASA issued a $980,488 contract to Pratt & Whitney for research on the use of fluorine and fluorine-oxygen (flox) mixtures as oxidizers with hydrogen, using components of the RL10 rocket engine which P&W is making for the Centaur.

Two weeks ago, NASA disclosed that it had awarded $366,593 to Rocketdyne and $209,625 to General Dynamics/Astronautics to study the use of flox in the Atlas propulsion system.

According to preliminary studies, this is how the propulsion alternatives measure out on a performance basis:

- **The two-stage Titan 2 would provide a 25-30% payload increase over the present one-and-a-half stage Atlas.**
- **Performance of an Atlas-Centaur using flox in the Atlas booster would be slightly under that of a Titan 2 and, using flox in the second stage Centaur as well, slightly above that of a Titan 2.**
- **Flox-burning Atlas combined with a Centaur second stage burning straight fluorine oxidizer would be even better.**

Johnson emphasizes that these alternative propulsion possibilities are simply being studied now and are not under active development.

At this point, he says, it is still too early for any definite decision. A decision to use one of these alternate propulsion schemes in the Centaur will depend upon such factors as future mission requirements, cost comparison of the alternatives and availability.

Other changes in the Centaur program by Lewis include redesign of the nose fairing, improvement of fabrication techniques, dynamic testing and complete vibrational analysis of the entire Atlas-Centaur vehicle.

In some cases, such as in some of the propulsion and guidance systems tests, Lewis has expanded and augmented programs already under way when it took over management of the Centaur program.

These changes in the Centaur program, particularly the great expansion in ground testing, came about for several reasons.

One was the realization by Lewis engineers and scientists, underscored by investigation of the earlier in-flight failure of the AC-1 test vehicle, that there were still a great many things they didn't know about the vehicle.

Another was the philosophy at Lewis, as expressed by the center's director Dr. Abe Silverstein:

"Everything that can be done on the ground in the way of test and checkout must be done perfectly on the ground, and in this way I think we can find 95% of the problems — and solve these problems on the ground before flight testing."

Also important, of course, was the fact that more money was put into the program to make this increased testing possible.

While the expanded test program has added to Centaur development costs, a Lewis spokesman said every effort is being made here and at other government and contractor test sites to hold these costs to a minimum.

At Lewis, for example, Centaur project engineers have used existing test facilities, which they have had to modify extensively in some cases, rather than build a completely new test facility for the program.

Of the new Centaur test facilities away from Lewis, the largest and most expensive is the $6.8-million combined

Dyna-Soar Suit

USAF/Boeing X-20 (Dyna-Soar) suit prototype affords pilot full protection should the spacecraft lose pressurization, according to Air Force Systems Command's Aeronautical Systems Div. Suit will be tested in a series of 15 live jumps (AW Sept. 30, p. 37) at El Centro, Calif. Model here is Maj. J. W. Wood, Dyna-Soar test pilot.

systems test stand now being built at San Diego.

Scheduled for completion late next year, the stand will be owned by NASA and operated by General Dynamics/Astronautics.

In it, Atlas, Centaur and the Surveyor payloads will be mated electrically for an end-to-end horizontal checkout of all systems except those involved in actual engine ignition.

It is expected that the stand will shorten the time required for testing at Cape Canaveral.

Until the stand is finished, NASA plans to use CD/A's interim combined test facility, which cannot handle the Surveyor spacecraft.

The new vertical separation test facility at Point Loma, Calif., which is much smaller, was nearly completed when Lewis took over the program, and it will be finished even though it offered more limited stage clearance space than Lewis' own stage separation test facility in Cleveland.

NEW AEROSPACE PRODUCTS

Metallizing Gun

Model TG-500 metallizing gun flame sprays ¼ to ⅝ in. zinc, molybdenum or ceramic rods and other materials at 2 in. to 25 ft./min. rates.

Gun weighs 4½ lb. and uses about 25 cu. ft./min. of air.

Avco Corp., Industrial Products Subdivision, Lowell, Mass.

Silicone Ablative

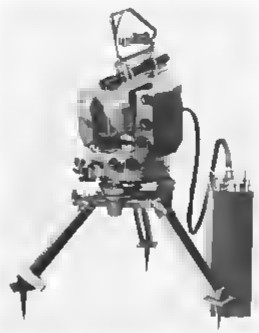
Silicone rubber low-density heat barrier material was developed for missile, supersonic aircraft and space vehicle applications.

The material called Dow Corning 325 ablative cures at room temperature and will bond to most metals, plastics and ceramics.

Dow Corning, Midland, Mich.

Velocity Monitoring System

Model 133A field sky screen monitors the velocity of rockets and missiles by recording the changes in the quantity of reflected light from the observed object falling on a photoelectric cell. It can also be used for acceleration measurements and as an optical tachometer.



The 6-in. f/2.7 lens is focusable from 20 ft. to infinity and is collimated to a 0.003 × 0.600 in. rotatable slit which is accurate to within 3 sec. of arc. Velocity and acceleration measurements require two and three instruments, respectively.

OPTOmechanisms, Inc., Engineers Hill, Plainview, N.Y.

Cryogenic Roller Bearing

Cryogenic roller bearing was designed for high-speed turbomachinery, electric motors, valves and actuators.

Bearing ran for more than 2 hr. in −423°F. liquid hydrogen at over 20,000 rpm. under a 2,000 lb. radial load, according to manufacturer. Dry operation of bearing due to interrupted flow is possible with unit's reinforced graph-

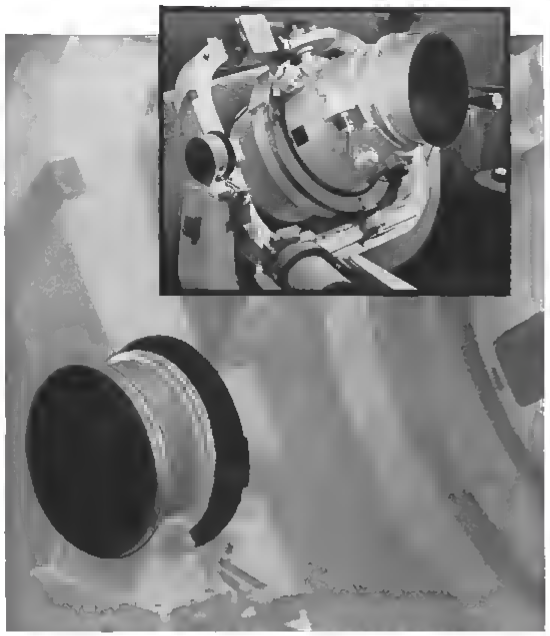


Photo-courtesy of Lincoln Laboratory, Lexington Mass.

ite or Teflon material separator, the manufacturer says.

Bore sizes from ¾ to 10 in. are available.

Industrial Tectonics, Inc., 18301 Santa Fe Ave., Compton, Calif.

Magnetic Field Surveyor

Portable magnetic field surveyor, Model 507, uses a Hall Effect generator as its sensor. Unit detects the direction and strength of d-c magnetic fields around electronic and power equipment as well as the earth's magnetism. Sensor and concentrator assembly are detachable for remote measurements with a connector cable.

Instruments Systems Corp., 111 Cantiague Rd., Westbury, L. I., N. Y.

Arc Imaging Test Facility

Arc imaging test facility is designed to evaluate solid propellant mixtures, ignition times, storage times, environmental effects and quality control of mixtures by electronically recording the time from application of a known heat flux on the test sample to the resulting flash time.

Hy-Cal Engineering, 12105 Los Nietos Rd., Santa Fe Springs, Calif.

Passenger Plane Stretcher

Model 1003 Aero-Stretcher is designed for use in either the Boeing 707 or Douglas DC-8 aircraft. Minor modifications permit use of the stretcher in the DC-6, DC-7 and also in the Lockheed 880, according to the manufacturer.

Stretcher collapses for packing in a 9 x 12 x 77 in. box which, when empty, telescopes to 9 x 12 x 48 in.

The total weight of the unit is 70 lb. This figure includes a 22-lb. packing box.

Acrotec Industries, Inc., Aerotherm Div., Bantam, Conn.

Knee Board Light

Flight lighting system, called Lumipane, is designed to provide uniform viewing of approach and letdown plates. Illumination system consists of a lower distributor element and an upper light trap ¾ in. apart.

Internal reflection of light rays from the distributor element is downwards on the map or chart which rests below the distributor.

Unit is 5 x 8 in., but can accommodate 10 x 10 in. unfolded sections of navigational maps through use of an end hinge.

Plumly Flite Products Inc., 5532 Calmont, Ft. Worth 7, Tex.

APOLLO TELECOMMUNICATIONS SYSTEM must provide wide variety of services, including voice data and television transmission from Lunar Excursion Module and command module to earth, as well as voice-data communications between the LEM and command module and radio inter-communications between astronauts on moon's surface. Location of telecommunications equipment in the command module is shown in sketch, right.

Apollo Communications Details Disclosed

By Philip J. Klass

Miami Beach—First details on the Apollo telecommunications system, the most complex spacecraft inter-intra-communications system yet developed, were reported here during the recent National Space Electronics Symposium.

The increased complexity results from the variety of communication functions which the system must provide. These include astronaut-to-astronaut within the spacecraft, command module to earth, command module to Lunar Excursion Module (LEM) during and after the lunar landing, roving astronaut to LEM to command module or to earth stations and roving astronaut to roving astronaut.

The report on the Apollo system was made here in two papers. One was authored by Samuel W. Fordyce of the National Aeronautics and Space Administration, and the other was jointly authored and delivered by W. S. Pope of North American Aviation and Dr. S. E. Watson of Collins Radio Co. Collins is the prime contractor for the Apollo telecommunications subsystem.

Discards Equipment

The Apollo mission, according to Pope, will spread communication equipment across a 250,000-mi. path—discarding some in the Atlantic Ocean, abandoning more in space, leaving some to orbit the moon, burning some to a gaseous state during re-entry, and retaining a little to aid in the location and recovery of the spacecraft once its flight has ended."

The VHF (very high frequency) portion of the spectrum used in Project Mercury for voice and data communications also will be employed in Apollo, both for the initial near earth orbit portion of the mission, and later for communications between the command module in lunar orbit and the LEM while approaching and after landing on the moon's surface, as well as for communication between the two astronauts on the moon's surface.

To achieve reliable communication over trans-lunar distances with the limited power and antenna size available, a microwave frequency in S-band (2,100-2,300 mc.) will be used for LEM-to-earth and command module-to-earth voice, television and data communications.

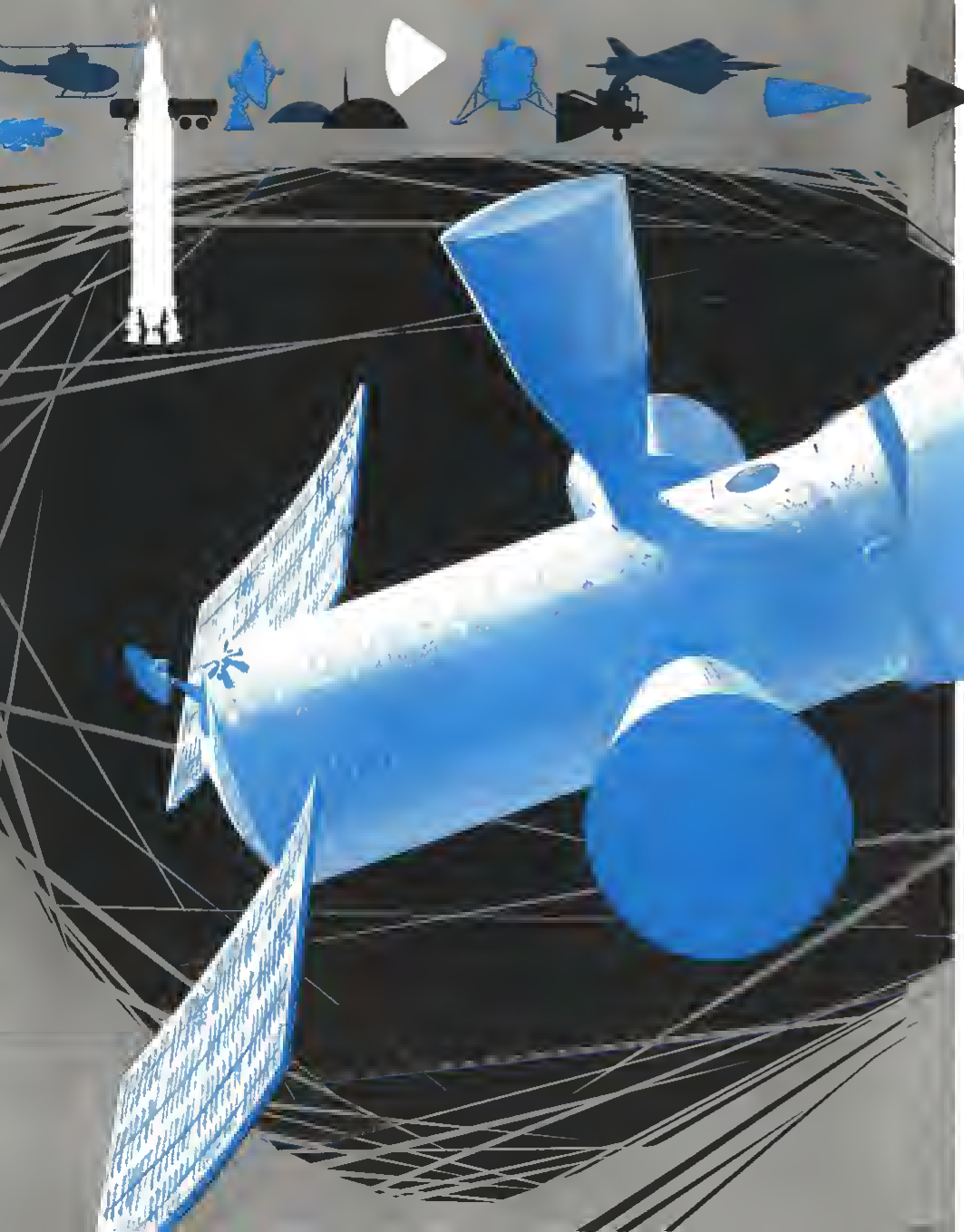
One factor in the choice of S-band is that the same frequency is suitable for use in radar tracking of the command module and LEM over lunar distances. This makes it possible to use a single transmitter-receiver in the command module and in the LEM. This transmitter-receiver functions both as a radar transponder for terrestrial trackers and serves to transmit and receive voice, data or TV. This portion of the Apollo telecommunications system therefore is referred to as the "unified S-band subsystem," to connote its multiple function nature.

Initial tracking of the Apollo vehicle during launch, near-earth orbit and trans-lunar injection will be accomplished by NASA's and USAF's existing network of AN/FPS-16 and AN/FPQ-6 C-band radars. Separate C-band transponders will be carried in the instrument unit (located between S-4B stage and spacecraft) and in the service/command module.

Tracking Functions

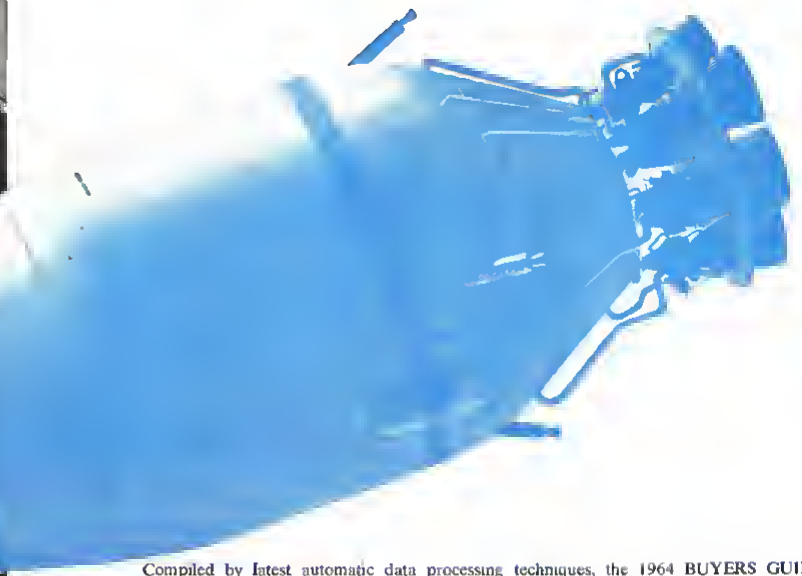
Present plans call for the C-band radars to handle the tracking function until the spacecraft has reached an altitude of several thousand miles during the injection phase, after which NASA's deep space tracking stations in California, South Africa and Australia will take over, tracking on S-band.

These three stations can maintain the Apollo spacecraft in continuous view only when it has reached an altitude of nearly 10,000 naut. mi., considerably beyond the effective range of the precision C-band radars. However, by adding two "gap-filler" S-band radars at key points, it may be possible to begin S-



1964 BUYERS GUIDE ISSUE

Unique in its Coverage of the World-Wide Aerospace Market



Compiled by latest automatic data processing techniques, the 1964 BUYERS GUIDE ISSUE promises to be the most accurate and complete edition in its nine year history.

Products, systems and services of over 4,000 U.S. and international manufacturers are listed in one easy-to-read section, covering satellites, space vehicles, missiles, aircraft, avionics, airline and airport equipment, supporting equipment and services. The section is divided into more than 2,000 product categories with the names of manufacturers listed alphabetically under each category.

In addition to detailed marketing reports on space technology, avionics, military aviation, air transport and business flying, the BUYERS GUIDE ISSUE contains comprehensive coverage on procedures for selling to the Department of Defense, the National Aeronautics and Space Administration and other government agencies. Also included are names, addresses and telephone numbers of government officials concerned with aerospace procurement.

BUYERS GUIDE ISSUE usage was demonstrated in a survey conducted six months after publication of the 1963 edition. It was found that 66% of the respondents still had their copy, and of these 55% referred to it at least once a month. This means that as an advertiser in the BUYERS GUIDE ISSUE, your sales message will be viewed and reviewed at the precise moment when buying decisions are made.

For advertisers whose contract is received before November 15th, your company's name and the page number of your advertisement will be featured in prominent bold-face capital letters for each of your listings. Of particular interest are special rates for multi-page advertisements. Also, available to advertisers using one or more BUYERS GUIDE ISSUE pages are 1/6th page, black and white advertisements adjacent to product listings.

For complete details on the many additional features and benefits of the 1964 BUYERS GUIDE ISSUE, contact your local AVIATION WEEK & SPACE TECHNOLOGY District Manager now.

PUBLISHED: MID-DECEMBER
ABC CIRCULATION: 86,219

Aviation Week & Space Technology

A McGraw-Hill Publication / 330 West 42nd St., New York N. Y., 10036

band tracking at altitudes of about 2,000 naut mi, providing sufficient overlap with the C band trackers

During initial staging of the Apollo launch vehicle, as it is brought to a circular parking orbit at an altitude of about 110 naut mi, a decision must be reached as to whether all elements are operational and whether or not to reignite the S-4B stage for trans-lunar injection. Data on the condition of the spacecraft and the astronauts will be radioed down by means of a pulse-code modulation/frequency modulation (PCM FM) telemetry transmitter operating in the 225-260 mc band at a rate of 51.2 kilobits per second. The VHF FM transmitter will have an output power level of 10 w, Fordyce told the recent symposium. The system will be capable of telemetering up to 270 different functions in time sequence. Telemetered data will include both biological and operational information, which will be relayed to the NASA integrated mission control center (IMCC) at Houston.

On board the spacecraft, the three astronauts will communicate with one another by means of an intercom network. A control panel for each astronaut will provide flexibility so that two astronauts can talk to each other while the third is talking to earth. Intercom provisions also are provided with the LEM for astronaut communications during the lunar-orbit phase of the mission.

During the near-earth orbit phase of the mission, data will be transmitted up to the spacecraft from terrestrial stations at a UHF frequency of 400-450 mc. This will include ground-derived data on spacecraft position and velocity for comparison with similar data obtained from vehicle's self-contained guidance and navigation system (AW Sept. 30, p. 32). Also transmitted on the "up-data link" will be advisory information or commands issued by the IMCC. The latter can be over-ridden by the astronauts by means of switches, Fordyce said.

Trans-Lunar Injection

When the decision is made to proceed with trans-lunar injection, the S-4B stage will be re-ignited to gain an additional velocity increment of about 10,000 fps. When the spacecraft reaches an altitude of several thousand miles where C band trackers are at the limit of their range, the trajectory should be well established, Fordyce said. But at this altitude the spacecraft's VHF AM voice signal would be of marginal strength for reception by existing facilities, and telemetry data would have been lost.

One possible solution is to replace the present quad-helical ground antennas with 60 ft dishes, providing an additional 14 db gain, corresponding to a five-fold increase in usable range. Additionally, the data rate for telemetry would be reduced from 51.2 to 1.6 kilobits. An alternate proposal under consideration is to switch from VHF to the unified S-band transponder for voice/data communications at an altitude of about 1,500-2,000 naut. mi., but this poses problems, because it may impose high tracking rates for ground antennas and provide only short tracking periods. Present plans call for feasibility tests on the latter approach during the early Apollo qualification tests, Fordyce said.

S-Band System

Once the switch-over is made from VHF to the unified S-band system, the NASA deep space instrumentation facility (DSIF) operated by Jet Propulsion Laboratory will become the sole means of voice and data communication with the spacecraft. Voice and data sent to the spacecraft will be transmitted at 2,100-2,110 mc while the spacecraft will reply at 2,280-2,290 mc.

When operated as a tracking radar, the DSIF stations will transmit a pseudo random noise code which will be transmitted back by the phase-locked spacecraft S-band transponder. From the returned signal the terrestrial station is expected to be able to measure spacecraft distance (range) to within 50 ft, Fordyce said. The range measuring technique is expected to be sufficiently precise to permit determination of range-rate as well as distance, enabling NASA to compute spacecraft trajectory and provide position/velocity data which the astronauts can compare with data obtained from the on-board guidance and navigation system.

These comparisons of spacecraft position and velocity will be made periodically during the passage of the moon and at arrival there prior to firing retro-rockets intended to place the spacecraft in a lunar orbit, hopefully at an altitude of about 80 naut. mi.

While the spacecraft is in lunar orbit, the moon will shield it from direct terrestrial communications for about half the orbit, or roughly 33 min. During blackouts, telemetry data will be stored in a tape recorder for subsequent transmission at an accelerated rate when the vehicle comes within view of the earth.

Descent Communications

When the LEM separates from the command module and begins its descent to the moon's surface, communications between the two spacecraft will utilize the VHF AM transmitter-receiver originally employed for command module-to-earth communications when it was in near-earth orbit. Voice communications from the LEM astronauts will be transmitted direct to earth from its own S band transponder, or can be relayed via the command module through the VHF-AM link if for any reason the earth station can not get through to the LEM while it is in transit.

Once the LEM has landed on the moon, the astronauts will erect a directional antenna about 10 ft. dia. providing the increased gain needed to transmit real-time television direct to terrestrial stations over its unified S-band subsystem. During voice-data transmissions, a power output of 5 w will be used.

The power output will be increased to 20 w to transmit TV and high-frequency biomedical type data.

When one of the astronauts emerges from the LEM for exploration, a small VHF-AM belt pack transceiver will provide radio communications to the other astronaut within the lunar spacecraft which in turn will be relayed by VHF-AM to the third astronaut in the command module, when it is within line-of-sight range. The portable transceiver is expected to provide usable range of up to 0.5 mi.

Television pictures of the lunar surface will be obtained using an analog type TV camera with a one-inch electrostatically focused videcon tube. It will have two lenses, one a 20-80 mm zoom lens providing a field of 9-35 deg and a wide-angle 9 mm. lens providing a 60-deg. field of view. Camera will have an automatic sensitivity control to adjust exposure to ambient lighting conditions.

A 320-line raster will be employed with a frame rate of 10 per second, providing a picture slightly reminiscent of old-time movies. The camera will weigh about 5.5 lb, consume about 6 w, Collins Radio's Watson reported.

When the LEM takes off from the moon for orbital rendezvous with the command module, both spacecraft will be within view simultaneously of an earth tracking station permitting it to monitor the initial phases of the operation and possibly provide some assistance. But optical and radar devices on board the spacecraft will provide the precise guidance information needed for final rendezvous. During the rendezvous operation, communications between the two spacecraft will be provided by their respective VHF AM transmitter-receivers.

Following crew transfer to the command module, the service module engines will be fired to inject the spacecraft into the transfer orbit back to earth. Voice and data communications will be handled by the unified S-band

Major Subcontractors

Major subcontractors and suppliers for the Apollo command and service module telecommunications subsystem, in addition to Collins Radio (see story), include:

- ACF Electronics: C-band transponder.
- Airborne Instruments Laboratory: Recovery antennas.
- Avien, Inc.: S-band high gain antenna.
- Barnes Engineering: Infrared sensors for orienting S-band antenna to earth.
- Elgin National Watch Co.: Central timing equipment.
- Epsco, Inc.: Telemetry signal conditioner.
- Hughes Aircraft Co.: Traveling wave tube for S-band transponder power amplifier.
- Leach Corp.: Tape recorder for data storage.
- Litton Industries: C-band antennas and klystron for back-up S-band power amplifier.
- Motorola: S-band transponder and UHF up-data link receiver.
- Radiation, Inc.: PCM telemetry.
- Radio Corp. of America: Television camera.
- United Electrodynamics, Inc.: Telemetry signal conditioner.
- Vector Mfg. Co.: Telemetry signal conditioner.

subsystem until the spacecraft reaches an altitude of several thousand miles at which time the VHF AM communications set will come into use and the tracking function will be transferred from the S-band radars of the DSIF network to precision C-band radars. Because the 36,000 fps re-entry velocity of the spacecraft is considerably higher than that of the Mercury capsule, the ionization sheath will build up faster and last longer, resulting in a VHF communications black-out expected to last about 10 min., compared with around 4 min. for Mercury, Fordyce said. A second blackout of shorter duration will occur a few minutes later after the spacecraft has "skipped" through the atmosphere and has begun its final re-entry.

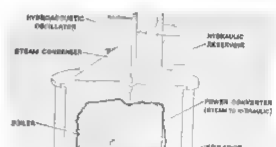
Just before re-entry, the service module containing the fuel cells which have powered all of the command module equipment will be jettisoned, leaving batteries as the only source of electric power. This will be sufficient to power a VHF rescue beacon, operating at 243 mc., which transmits a 1,000 cps tone and has a power output of more than three watts, Watson reported. The command module's VHF AM communications set will be operated in the receive-mode only. Additionally, the astronauts will have a high frequency (HF) transceiver operating at 15 mc. with power output of five watts to permit two-way voice communications with search aircraft at distances of more than 100 naut. mi. However, the modest battery power will require that only limited use be made of this.

The complexity of the Apollo telecommunications subsystem and the two-week mission time during which it must perform will require a ten-fold improvement in mean time-between-failure (MTBF) of the equipment over that of the Mercury, Dr. Watson said. To achieve the increased reliability, Collins and its associated contractors are:

- Using Minuteman-qualified components wherever possible, with additional testing in some instances to meet the Apollo requirements. Where required parts are not available from Minuteman sources, separate qualification tests are being conducted.
- 100% acceptance testing of all components, including both sample tests to prove quality of each lot and tests on every component.
- Individual identification and records for each component through the component manufacturing process to final installation to permit faulty items to be traced back to their cause and to locate others which might have been adversely affected.
- Conservative derating of components to reduce component temperature rise and extend MTBF.

Even with these steps it is not possible to assure the high level of reliability which Apollo demands.

Payload weight limitations preclude the use of dual equipments for all mission functions. Instead, spare plug-in modules will be carried for those circuits whose MTBF appears marginal and the astronauts will perform in-flight maintenance if required. To assist them in locating the faulty module, the spacecraft will be equipped with an in-flight test system and all equipments have been made accessible from within the command module. (See sketch p. 87)



Sonar Beacon

Atomic-powered sonar beacon to serve as navigation aid for submarines is being developed by Martin Co. under a $110,000 Atomic Energy Commission contract. Beacon will emit high pitched squeal, generated by oil flowing through hydro-acoustic transducer, powered by heat from radioisotopes. Beacon fits inside 1 cu. ft. volume.

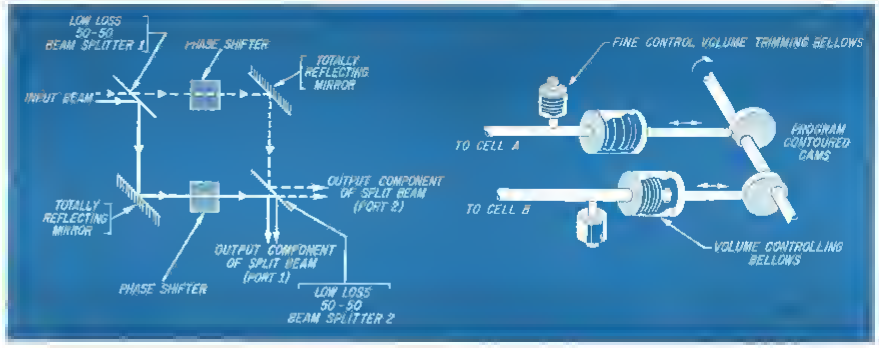
PROBLEMATICAL RECREATIONS 193

1960 and 1961 were bad years for ice cream sales but 1962 was very good. An accountant was looking at the tonnage sold in each year and noticed that the digital sum of the tonnage sold in 1962 was three times as much as the digital sum of the tonnage sold in 1961. Moreover, if the amount sold in 1960 (346 tons), was added to the 1961 tonnage, this total was less than the total tonnage sold in 1962 by the digital sum of the tonnage sold in that same year. Just how many more tons of ice cream were sold in 1962 than in the previous year? —*Contributed*

More than 30 million additions per minute can be performed by our new C-820 computer. The highest speed digital computer ever built for operation in aircraft and spacecraft. Developed for the Flight Control Laboratory of the Aeronautical Systems Division of the Air Force, the C-820 is part of an advanced program to provide an integrated flight control system for an aerospace vehicle. Contact the Marketing Dept. of our Guidance and Control Systems Division, Woodland Hills, California.

ANSWER TO LAST WEEK'S PROBLEM: It's a well known fact that n^2+n+41 is prime for $n < 40$. Since it is greater than 3, such a number is of the form $6k \pm 1$, which is one more than a multiple of 12 when squared.

LITTON INDUSTRIES
Beverly Hills, California



INTERFEROMETRIC MODULE EMPLOYS two phase shifters (left) which shift phase of laser beam by equal but opposite amounts. Outputs can be attenuated from zero to 30 db. Drawing of bellows system (right) for controlling pressure of gas in phase-shifting cells of optical component shows non-linear programed cams which tune phase shifters, developed by Electro-Optical Systems.

New Module Splits Laser Beams

Pasadena, Calif.—An optical component of a type which could be an important element in an optical maser phased array which may be necessary in realizing practical optical air/space surveillance and communications systems was developed here recently by Electro Optical Systems, Inc.

Called an interferometric module, the component makes it possible to divide a coherent optical beam generated by an optical maser, attenuate and recombine the divided beam in phase or at any controlled phase relationship.

The interferometric module was developed under one of a series of research and development contracts, totaling nearly $1 million, which the company received over the past two years from Air Force's Rome Air Development Center to investigate and develop optical surveillance devices as well as techniques.

One of Electro-Optical's goals is believed to be a laser CW oscillator, pulsed amplifier and laser heterodyne, all operating on a common, compatible spectral line. A laboratory model of an optical phased array also is expected to be built here within the next year (AW Apr. 22, p. 64).

Shown in accompanying drawing (above), the device consists of a single

interferometer configuration containing two gas cells, or phase shifters, which can shift the phase of the laser beam through 360 deg. Each phase shifter is situated between a beam splitter, one side of which is coated with an anti-reflective coating, and a totally reflecting mirror.

The two arms of the module, each containing a beam splitter, phase shifter and reflecting mirror, but in reverse order, are arranged to form a rectangular-shaped device with reflecting surfaces of the mirrors at diagonally opposite corners of the device.

Beam Splitter

When the input beam supplied by the laser strikes the first beam splitter, it is divided so that half of the beam is directed through the phase shifter, onto the totally reflecting mirror, then rotated through 90 deg in direction and directed onto the second beam splitter. The second half of the beam, which is reflected from the input splitter, is reflected again by the other reflecting mirror, passed through the second phase shifter and then onto the output splitter.

Phase shifting is controlled precisely by control of the gas pressure within the phase shifter cells. The nature of the gas is a function of the wavelengths of the laser, but for visible wavelengths, such as those generated by ruby and helium-neon gas lasers used in tests here, clean dry air is sufficient, according to the company.

The wavelengths of interest to the Air Force in this investigation range from 5,000 A in the visible spectrum to 8,000 in the near infrared, straddling the spectral lines of both types of lasers.

Tuned Simultaneously

The two phase shifters are tuned simultaneously with a pressure control bellows system driven by a non-linear programed cam. By manually turning a screw thread, one can open and close a bellows associated with each cell by equal, but opposite amounts, thereby altering the phase shift in each of the cells.

An additional bellows provides for trimming the phase of each cell.

Two outputs representing a recombination of the split beams are available from each side of the output beam splitter.

The beams at either output can be attenuated from zero when equal in phase to 30 db when they are out of phase.

Only one output can be attenuated the full 30 db.

If the module or some derivative of it were to be employed in a practical system, the outputs could be fed to individual amplifiers as an initial step in a phased array.

FILTER CENTER

►**Measuring Hypersonic Plasma With Lasers**—General Electric is about to receive a contract from the National Aeronautics and Space Administration to investigate the use of a ruby laser for measuring the hypersonic flow field plasma parameters from the incoherent scattering of light.

►**Unfurling Solar Collector to Get Space Test**—A space test of an experimental 10-ft. dia. unfurling solar collector which could gather the sun's rays and focus them onto an energy conversion device will be conducted by Lockheed Missiles & Space Co. aboard an Agena spacecraft. Launched in a folded configuration, the collector will unfurl in space much like the petals of a rose. The collector will be built by Electro-Optical Systems under a program called ROE (reflector orbital experiment).

►**Interaction of Laser Beams With Matter**—One-year investigation into the causes of damage to optical components by high power laser systems will be conducted soon under a forthcoming Army Signal Corps program. The investigation is aimed at uncovering improved optical components and will center on multi-layered dielectric reflective coatings, anti-reflection coatings, lenses, prisms, and the laser medium itself.

►**Sprayed Solar Cells**—Research on chemically sprayed thin film solar cells is being conducted by the Physical Research Dept. of National Cash Register.

►**Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **Electronic Communications, Inc.,** Research Div., Timonium, Md., will investigate a multi-aperture adaptive antenna system for receiving telemetry data from distant space vehicles, under $50,000 contract from NASA's Goddard Space Flight Center.

• **Honeywell's Aeronautical Div.,** Minneapolis, will prepare preliminary designs for high-performance control system components suitable for Nike X missile under letter contract awarded by Martin Orlando.

• **Radio Corp. of America** will study vanety of all-weather landing techniques for Army aircraft under contract for $200,000 from Army Electronic Research and Development Laboratory. The 12-month study will be conducted by RCA's Aerospace Communications and Controls Div., Camden, N. J.

■ **Burroughs Corp.,** Detroit, has received contract for $12.6 million for 17 additional D 825 data processing systems to be used with USAF's Back-Up Interceptor Control (BUIC) program. Thus extension raises total contract price to $37 million for total of 34 systems.

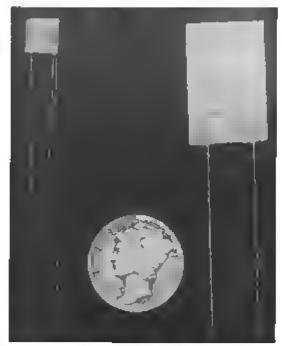
• **Ling-Temco-Vought** will build and install an Inconorama display for NASA's Nimbus-Tiros meteorological satellite control center at Goddard Space Flight Center under $45,000 contract.

• **Electro-Mechanical Research, Inc.,** Sarasota, Fla., will design and build nuclear radiation resistant telemetry equipment for Army's Harry Diamond Laboratories and for Sandia Corp. under two separate contracts. Army contract calls for a voltage-controlled oscillator whose operation does not deteriorate under a peak gamma flux of 10^9 roentgens/sec and an integrated neutron flux of 10^{14} neutrons/sq. cm having energies greater than 10 kev. The Sandia award calls for development of subcarrier oscillators, low level amplifiers, voltage regulator, commutator and calibrator.

• **Sperry Phoenix Co.** will continue its efforts to define control display system integration and pilot functions during approach and landing of advanced aircraft for USAF's Aeronautical Systems Div.

NEW AVIONIC PRODUCTS

• **Low-mass temperature transducer,** Series FC, offers fast response and



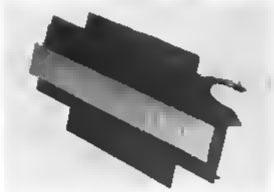
greater change of resistance per degree temperature change than a conventional thermocouple. Device is encased in an 0.008-in. thick molded glass fiber

envelope which can be bonded to curved or flat surfaces. Manufacturer: Tylan Corp., 4203 Spencer St., Torrance, Calif.

▪ **Catwhisker wire shaper,** using electrolytic action, can produce sharp points of the order of 0.005-0.0005 in. using

wires made of tungsten, phosphor bronze and beryllium copper. Device, intended for laboratory use, has pin vise and drive mechanism for holding wire. Manufacturer: ECI Research, 1830 York Road, Timonium, Md.

▪ **Butler antenna array** containing eight printed-circuit spiral elements, Model 02-40, for operation in the 2-4 gc. (kmc.) band, measures 8x16x2½ in. and weighs only 4½ lb. The array, suitable for electronic warfare and phased-array

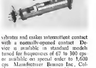


radar applications, provides eight simultaneous overlapping independent beams with uniform taper, seven beams with cosine taper or six beams with cosine-squared taper by use of beam combining networks. Manufacturer: Advanced Development Laboratories, Inc., 24 Simon St., Nashua, N.H.

▪ **Miniature d.c. rotary solenoid,** Magton Series 11, measures ⅝ in. in diameter and ⅞ in. long, produces ½ oz.-in. torque and consumes 0.3 watts power. Solenoid employs balanced construction with no axial movement of shaft and is available in variety of wire sizes. Manufacturer: Magton, Inc., 110 No. Wacker Drive, Chicago, 60606.

(Continued on p. 102)

• **Resonant-reed selective filter,** Model RD-10, consists of tuned reed which would vibrate as single tine of a tuning fork except that it is biased by a permanent magnet When a c signal of selected frequency is applied, reed



vibrates and makes intermittent contact with a normally-opened contact Device is available in standard models tuned for frequencies of 67 to 300 cps or available on special order to 1,600 cps Manufacturer Bramco Inc, College & South Streets, Piqua, Ohio

• **Diode-laser pulser,** Model A, permits selection of any desired current pulse amplitude, with upper limit of 140 amperes into 1-ohm impedance Current pulse can be delivered as single shot or repeated at 60 pps rate Using external oscillator, current can be pulsed at 5 to 110 pps Trigger output is provided for synchronizing external devices Rise time is quoted at 0 2 microsec with fall time of 0 5 microsec into a 1 ohm resistive load Manufacturer Seed Electronics Corp, 258 East St, Lexington 73, Mass

Resistor Networks

Twelve identical thin-film resistor networks, each containing seven metal oxide resistors, are deposited on a 1¼ x 2 in glazed alumina substrate Life tests totaling more than 800,000 resistor hours over a year's time show no failures and maximum resistance change of only 0.57% under MIL Spec test at 70C with rated power cycled on-off on thin film resistor networks of this type according to Corning Microcircuit Dept Corning Glass Works, Corning, N Y

EMPLOYMENT OPPORTUNITIES

Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and — more advertisers mean more information on more products or better service — more value—to YOU.

FOR INFORMATION

about Classified Advertising

contact the McGraw-Hill office nearest you

ATLANTA 30309
J LANE
1375 Peachtree St, N E
875-0523 (Area Code 404)

BOSTON, 02116
J WREDE
McGraw Hill Bldg, Copley Square
COngress 2 1160 (Area Code 617)

CHICAGO, 60611
WM HIGGENS—G AMBROZE
645 No Michigan Avenue
MOhawk 4-5800 (Area Code 313)

CLEVELAND, 44113
B HABTER
55 Public Square
SUperior 1-7000 (Area Code 216)

DALLAS, 75201
J GRANT
1712 Commerce St, Vaughn Bldg
Riverside 7-9721 (Area Code 214)

DENVER 80202
J PATTEN
1700 Broadway, Tower Bldg
255-2981 (Area Code 303)

DETROIT, 48226
T JAMES
856 Penobscot Building
962 1793 (Area Code 313)

HOUSTON, 77025
K GEORGE
Prudential Bldg, Holcombe Blvd
Riverside 8-1280 (Area Code 713)

LOS ANGELES, 90017
R McGINNIS
1125 West Sixth Street
HUntley 2-5450 (Area Code 213)

NEW YORK, 10036
D HAWKSBY—H BUCHANAN
500 Fifth Avenue
971-3596 (Area Code 212)

PHILADELPHIA, 19103
WM SULLIVAN—B LEWIS
Six Penn Center Plaza
LOcust 8-4330 (Area Code 215)

PITTSBURGH, 15222
4 Gateway Center
391 1314 (Area Code 412)

ST LOUIS 63105
J CROWE
7751 Carondelet Avenue
PArkview 5-7285 (Area Code 314)

SAN FRANCISCO, 94111
J A HARTLEY
255 California Street
DOuglas 2 4600 (Area Code 415)

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES — **EQUIPMENT - USED or RESALE**

DISPLAYED RATE:

The advertising rate is $31.00 per inch for all advertising appearing on other than a contract basis. Contract rates on request.

AN ADVERTISING INCH is measured 7/8 inch vertically on one column. 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE:

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv Div of Aviation Week P O Box 12 N Y., N Y 10036

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK, N Y 10036: P O Box 12
CHICAGO, Ill 60611: 645 N Michigan Ave
SAN FRANCISCO, Cal 94111: 255 California St

BUSINESS OPPORTUNITY

Revolutionary Vertical rising Aircraft. Seek capital, mfg facilities to build models. U.S. Govt. Interested. Potential unlimited. BO 3237 Aviation Week/ST

WANTED

Anything within reason that is wanted in the field served by Aviation Week can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, OCTOBER 21, 1963

CLASSIFIED ADVERTISING

F J Eberle, Business Mgr

ADVERTISERS INDEX

LETTERS

West Ford

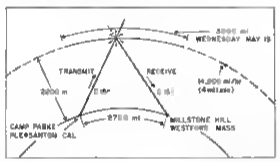
I have just read your article on the West Ford experiment in today's (Sept. 30, p. 95) issue of AVIATION WEEK & SPACE TECHNOLOGY. Early paragraphs in the article read as follows:

Peak transmission rates were attained only during the early days which followed formation of the orbiting dipole belt.

"The orbiting dipole belt of copper needles formed completely about June 18, forty days after the dispensing mechanism ejected them.

"Transmission of information has now decreased to about 1,000 bits/sec."

It is not clear to me from this wording whether you are aware that the 'peak transmission rates' were in fact measured in the first week after the dipoles were released by the dispenser, when all the dipoles were still concentrated along only a few thousand miles of the 40,000 mi. circular orbit, and long before they were distributed all around the circle to form a 'belt' (see diagram).



On June 18, the ends of the long, thin circular cloud of dipoles first began to overlap and intermingle, and the distribution of dipoles around the circular belt became increasingly uniform for several months thereafter. The data rate of 1,000 bits/sec refers to the performance of the completed belt in the latter part of August, when the belt had "formed completely."

In view of your continuing interest in this project, I want to be sure that this sequence of events is clearly established.

JOHN V. KESSLER
Massachusetts Institute of Technology
Lincoln Laboratory
Lexington, Mass.

(AVIATION WEEK & SPACE TECHNOLOGY used the description of Walter E. Morrow, Jr., of Lincoln Laboratory, cited in the story which said that, "higher transmission rates were achieved only during the early days of the belt." Since the use of the term belt could imply a full circle, Mr. Kessler's letter resolves any ambiguity that might have arisen—Ed.)

Cooper (Cont.)

With regard to reader Strumbos' letter (AW Sept. 30, p. 106), I should like to state that, contrary to the inference, astronomers are acutely aware of the effects of atmospheric refraction. The geometry proposed by Mr. Strumbos is essentially correct in illustrating the magnifying effect of the atmosphere. His explanation would have been more lucid, however, if he had inserted the significant numbers. The index of refraction of air at sea level is approximately 1.0003 and we may take the atmospheric scale height to be roughly 5 mi. Thus to an observer in space the atmosphere would make objects on the earth's surface appear 8 ft. closer—yielding an increase in their apparent dimensions of 0.0015%, as seen from an orbital altitude of 100 mi. This should conservatively establish my earlier contention that the atmosphere gives negligible visual advantage. Reader Strumbos' argument would have been better taken had Mat. Cooper viewed the earth's surface through 100 mi. of water.

BRADFORD A. SMITH
Associate Astronomer
New Mexico State University
University Park, N. Mex.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Not to belabor the point, but if the Mercury capsule can be seen in orbit by observers on earth—5 min. sighting by crew of the Indian Ocean ship of Schirra—why should we doubt an astronaut's ability to see comparable objects on earth?

That some people also question Cooper's ability to identify these objects is to further ignore his capability to make intelligent interpretations.

WENDELL STILLWELL
Lancaster, Calif.

'Big Lift' Useless

I have been watching, with increasing dismay, the reliance being placed on long range transport aircraft for the movement of troops to potential battlegrounds overseas. Operations of this type are only feasible during peacetime, while 10,000 ft. runways are in perfect condition, landing aids are in operation and support equipment is readily available. In this context, the projected Exercise Big Lift is completely meaningless as far as possible movement of troops in wartime is concerned.

As long as military transports must rely on prepared surfaces, easily detected and destroyed by short or medium-range missiles the whole concept of such troop movements is not practicable in wartime.

The Soviet Union seems to be on the right track with their project to build a 2,000-passenger, water based aircraft. It may not be feasible with the present know how to manufacture an aircraft of this size, but the advantages of operating from water are obvious, even though peacetime operating costs would be much higher, due to the unfavorable payload/weight ratio inherent in such aircraft.

In view of the above the idea of reducing troops stationed in Europe by one division each year, based on the availability of additional military air transports, is suicidal. People who should know better, such as Sen. Russell, will have to take a great deal of blame for any disastrous consequences such a policy might have.

R. STARGARDTER
Stargardter Enterprises
New Orleans, La.

Credit Given

Your story on our Gyroflex (AW Sept. 9, p. 100) was, as usual, a good one. I would like, however, to note an omission on our part: the Avionics Lab. of the Air Force's Aerospace Systems Div. should have been credited with support of the program through its conceptual and development stages.

H. HELLMAN
Manager
Information Services
General Precision, Inc.
Aerospace Group
Little Falls, N.J.

Electron Beam

I would like to point out that in the article in your Sept. 23 (p. 80) issue entitled 'Electron Beam Technique Makes Inspects Semiconductor Microcircuits,' insufficient acknowledgment was made to the important role played by Dr. O. C. Wells in the work described. In fact, the Scanning Electron Microscope now being used by these laboratories was designed and constructed primarily by Dr. Wells and he has also carried out many of the investigations outlined in your article.

I. M. MACKINTOSH, Manager
Information Devices Dept.
Research & Development Center
Westinghouse Electric Corp.
Pittsburgh, Pa.

Argosy Error

Re "Argosy Production" (AW Sept. 9, p. 28). As to Siddeley should have no trouble selling the 10 Series 200 Argosies. Imagine, a 90,000-lb. airplane with a 310,000 lb. payload! Did an extra zero creep in unnoticed?

Seriously, all misprints aside, you are to be congratulated on a fine magazine which has, for the last three years, given at least one future engineer a most informative and occasionally amusing view of his future in the aerospace industry.

MITCHELL J. GRAYSON
Cornell University
Ithaca, N.Y.

(Our mistake. The Argosy will carry a 31,000 lb. payload.—Ed.)

\ND FACTOR"

The Phantom II can operate with combat loads, from runways less than 5,000 feet,

AND... deliver a conventional bombload of 4,500 pounds,

AND... utilizing one of two Bullpup guided missiles, visually sight and destroy a railroad bridge,

AND... with the other, wipe out a missile launch hard-site facility,

AND... with the still remaining Sparrow III missiles, destroy enemy aircraft or air-breathing missiles, even in head-on attacks,

AND... operate in any kind of weather, day or night,

AND... accomplish all these missions 500 statute miles from this base, with fuel left for the return.

Defense planners recognized this "*AND FACTOR*" versatility when they chose the multiple-mission Phantom II for the United States Navy, United States Marines and United States Air Force.

MCDONNELL

Gemini, Asset and Aeroballistic Spacecraft •
Phantom II Fighter, Attack and Reconnaissance Aircraft • Electronic Systems and Equipment •
Talos Missile Airframes and Engines • Automation

ST. LOUIS

Engineers and Scientists: Employment opportunities exist at McDonnell. An Equal Opportunity Employer. For information, write: McDonnell, Box 516, St. Louis 66, Mo.